MAY, 1924

MECCANO MAGAZINE

For Boys

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VOL. IX Nº 5

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MECCANO MAGAZINE

PUBLISHED
IN THE INTERESTS
OF BOYS

THIS issue of the "*M.M.* comes to you in the first of a new series of covers. The special character of these covers, which I think will appeal to all my readers, is unique, and I do not think there has been anything like them in any other magazine.

Our New Covers

Each month in future our cover will, as far as possible, illustrate one of our special articles. This month's cover, for instance, shows an electric crane handling a huge ingot of steel, cast from one of the giant furnaces in the background. The cover is intended to illustrate the serial article, "*The Story of Iron and Steel*," that commences in this issue. If my readers could see some of the splendid covers that have been arranged for our future issues I am sure that their eyes would sparkle and there would be numerous exclamations of delight! The designs in hand include further wonderful photographs in connection with the steel industry, and also designs for bridges, giant cranes, and other similar structures in which "*M.M.*" readers are more particularly interested. It is my intention to make the "*M.M.*" the leading magazine for intelligent boys, and it is in keeping with this intention that the publication should have unique covers, which I feel sure everyone will admire.

I often wish that my readers could look over my shoulder as I go through my morning mail. Every day they would see hundreds of letters from enthusiastic readers in every corner of the earth, and written in all manner of queer languages! Some of my correspondents ask me questions on a variety of subjects, many of which are not connected with Meccano, nor even with engineering. Others criticise past issues and make suggestions for new articles for the future. Both these kinds of letters help me, for I welcome criticism and suggestions. As I think I have previously explained on this page, it is a very difficult matter to please 100,000 readers, and as far as possible the subjects dealt with in each issue follow the demands of the majority.

Helpful Suggestions

In editing a magazine it is very necessary to look well ahead, and no doubt it would surprise many of my readers to know that preparations for the issue of almost every magazine are made some months before the particular issue is due to appear. This is why magazine artists often are engaged in designing Xmas covers, with ice and snow scenes, in the sweltering days of August! Some day I hope to tell in the pages of the "*M.M.*" the story of how a magazine is printed and published, and my readers will then be better able to understand the difficulties that confront editors. It is because of these difficulties and this forward preparation that, although a large number of readers have asked for various new features, I am not able to introduce these new features for some little time. I have already been able to commence a cycling page in response to the insistent demands from my readers, and this page I hope to continue, at any rate during the summer months. To those impatient ones who keep writing to me on the subject, I would say that I am hoping to arrange for the inclusion of a regular page on railway topics before very long. Meantime, I am able to promise in the near future another Nature article by Master Moore-Hills, who has already contributed to our pages.

Preparing Beforehand

This month we conclude the article on the Life of George Stephenson, and next month we hope to say something about his son, Robert, who was no less famous an engineer than his illustrious father. It is true that Robert Stephenson had not to fight poverty and want, as was the case with his father, but nevertheless he was faced with many difficulties, and in our next issue we shall tell how he overcame some of them. Our next instalment of the article on Electricity will deal with the electric current, primary cells and accumulators—subjects of great interest to all Meccano boys. We shall follow this with articles dealing with magnets and magnetism, accompanied by details of some further interesting experiments.

Good Things in Store

Several fine new models have been perfected by the model-building staff of Meccano Ltd. during the past few months. In this issue we publish a description of the first of these—a Reaping Machine. This description will be followed by others as space permits. The models dealt with will include a very fine example of a Radial Crane; Weighing Dockside Crane (which weighs its load as it hoists, and automatically shows the weight on a scale); Horizontal Steam Engine. High and Low Pressure Steam Engine; a very efficient model of Platform Scales, which will actually weigh, and many other models of interest. Advanced model-builders will be pleased to hear that the model of the High-Speed Ship-Coaler has now been revised and that I am hoping to publish full instructions for building this splendid model in the near future.

COMPLETE YOUR "M.M." FILES

Those who wish to make up complete sets of "*M.M.'s*" will be interested to hear that we have in stock a few copies of recent issues.

All Magazines up to and including December, 1921, are out of print. A few dozen copies remain of each number from January to December, 1922 (with the exception of November), and copies of each of the 1923 issues are also available. Copies will be sent post free, price 3d. each, but early application should be made, as the number available is very small.

Our £250 Championship Competition closed last month for entries in Great Britain, and closes for the Colonies on the 31st instant. As there are thousands of entries to be examined the judges will probably be kept busy for two or three months. We shall, of course, announce the results in the "*M.M.*" as early as possible, and every entrant will receive a copy of the Magazine in which the results are published. In the meantime I would remind all readers of the special model-building competition that has been arranged in connection with the series of articles on Steam Shovels and Draglines that appeared in our recent issues. Full particulars of this contest were announced on page 89 last month, and I hope that a large number of readers will endeavour to win the £5 cash prize offered by Messrs. Ruston & Hornsby Ltd. for the best Meccano model of their giant Dragline.

Our Competitions

I. FROM THE STONE AGE TO THE IRON AGE

ALTHOUGH all Meccano boys are familiar with steel—for they use it every time they build a model—how many of them realise the absolute dependence of the whole world upon steel? From the knife that we use at the breakfast table to the mighty guns of our battleships, steel plays its all-important part in the daily life of everyone. If the supply of steel came to an end, not only would the Meccano factories have to close down—terrible thought for a Meccano boy!—but so also would every other factory.

The great variety of purposes to which iron may be applied makes it of more value to the world than all the other metals together. Iron has been well called "The soul of every other manufacture."

The Importance of Iron

Steel is made from iron, and so iron is all-important to home life and industry. Just imagine for a moment what would happen if it became possible to cause all iron to disappear in an instant, by some fierce newly-discovered ray. Think what would happen in your own home. Iron bedsteads would vanish, the gas-oven, kitchen range, bars of the fire-grate, iron pans in the kitchen—all would disappear, together with a host of other things too numerous to mention. The great mains bringing gas and water to the house would melt away, and supplies would be cut off. Where could we sleep? How could we cook our food? Where should we obtain water?

If such an occurrence caused all this trouble in our home, we can imagine what terrible disaster it would bring to the world itself. Indeed it would mean that the whole of our civilisation would immediately collapse. Our industries would be brought to a standstill, and trade and transport would receive their death blow.

Stone Age to the Iron Age

The Story of Iron and Steel is a wonderful romance. In order to fully appreciate it we must go back to pre-historic times, to the earliest men of whom we have found any trace. The history of civilisation may be divided into three great epochs, according to the nature of the tools used in each. First there was the Stone Age, in which the use of metals was almost unknown, implements and weapons being made chiefly from bones, stone and flints. Then followed the Bronze Age, in which bronze, a metal composed of copper and tin, began to be employed and gradually came into general use. Bronze made possible a great advance, for it could be fashioned into a variety of weapons and tools, to which considerable hardness could be given. Finally came the discovery of the art of smelting and working iron, and so the Iron Age, in which we now live, came into existence.

The reason why iron was the last of the metals to come into general use is that, although one of the most widely diffused metals, iron is never found in a pure state except in meteorites. Considerable skill is required to recognise the ore, and then to separate the metal from the materials surrounding it. The art of smelting and working iron came from the East, and the metal is frequently referred to in the Bible. It is quite possible that iron was discovered by the accidental heating of a mass of ore in a fire.

Photograph [*Messrs. Dorman, Long & Co. Ltd.*

Working at the Face in an Iron-ore Mine

Iron in Ancient Britain

We know very little about the early history of iron in Britain. It is fairly certain, however, that the metal was known to the natives at the time of the Roman invasion, but the stories of British chariots armed with swords or scythes must be regarded as entirely imaginary. Not only was iron too scarce to make such horrible weapons, but there were no roads suitable for chariots!

The Roman invaders quickly began to smelt iron on a fairly large scale, wherever they came across the ore. They had keen powers of observation, as is illustrated by the fact that ancient workings have been discovered in several districts, such as North Yorkshire and Northamptonshire, proving that the Romans were well acquainted with certain beds of iron ore of which we knew nothing until some 80 years ago.

The chief iron mines worked by the Romans were in the southern counties and on the borders of Wales; it is very interesting to learn that the Romans had forges in the Forest of Dean and in South Wales some 1800 years ago, and that from these forges they sent the metal to Bristol to be made into weapons.

The Smith Family

Have you ever wondered why there are so many people named Smith? At the time of which we have just been writing, and for a long period afterwards when nations were almost continually at war with one another, there was a large number of smiths. These men forged weapons and armour for the warriors and were held in the highest esteem, being, indeed, very important men in the days when the results of battle depended to a large extent on the quality of the weapons and the armour they forged. It is easy to understand that the name of Smith, or its equivalent in other languages, became common when surnames came into use. The families of to-day named Smith are descendants of these smiths of olden days.

Ironworks in Sussex

To trace the early history of iron in detail would require

more space than we can give in the "*M.M.*" Except for stating that the metal continued to be worked in an increasing number of districts, we will make a big jump forward to the 14th and 15th centuries.

During this period the supply of English iron was not only insufficient to meet the demand, but the home-produced metal was also more expensive and of poorer quality than foreign iron. The English market at this time was therefore mainly supplied with iron and steel from Spain and Germany. Later a revival in iron manufacture took place in Sussex, where there were large quantities of ironstone and also an abundance of wood for smelting the ore. This revival reached its height in Queen Elizabeth's reign, when supplies were so abundant that England began to export iron in the form of cannon. A startling result of this was that the Spanish ships were found to be fighting us with guns of our own manufacture! As a consequence, the export of iron ordnance was prohibited, although the smuggling of Sussex guns to Spain continued on a large scale for a long tine.

Smelting by Coal

Presently people awoke to the fact that the Sussex ironmasters were rapidly using up all the trees of the great forests, and it was feared that before long there would be no fuel left within reach of London, for at this time wood was used as fuel, coal being practically unknown. The result was that in 1581 an Act was passed prohibiting the conversion of wood into charcoal for the making of iron within 14 miles of the Thames. At a later period further restrictions on the use of timber were imposed, and the effect was to nearly kill the iron industry.

In 1620, Dud Dudley, son of Lord Dudley, of Dudley Castle in Worcestershire, took out a patent for the smelting of iron with coal. His method was successful, but the great iron smelters, jealous of his success, spread reports about the poor quality of his iron, and so persecuted him that finally he had to give up the struggle.

At last the increasing demand for iron, and the decreasing supply of timber for smelting, forced the ironmasters to turn to coal. Abraham Darby, of Coalbrookdale, in Shropshire, was the first to make a financial success of smelting by coal, and made a fortune by casting iron pots for use in cooking. It is interesting to note that the first iron bridge ever erected was made at the Coalbrookdale works by a grandson of the founder.

The success of Abraham Darby, and of others who followed his example, convinced even the most old-fashioned ironmasters that the days of smelting by timber were over, and the manufacture of iron improved steadily and rapidly, one technical improvement following another as the ironworkers gained experience.

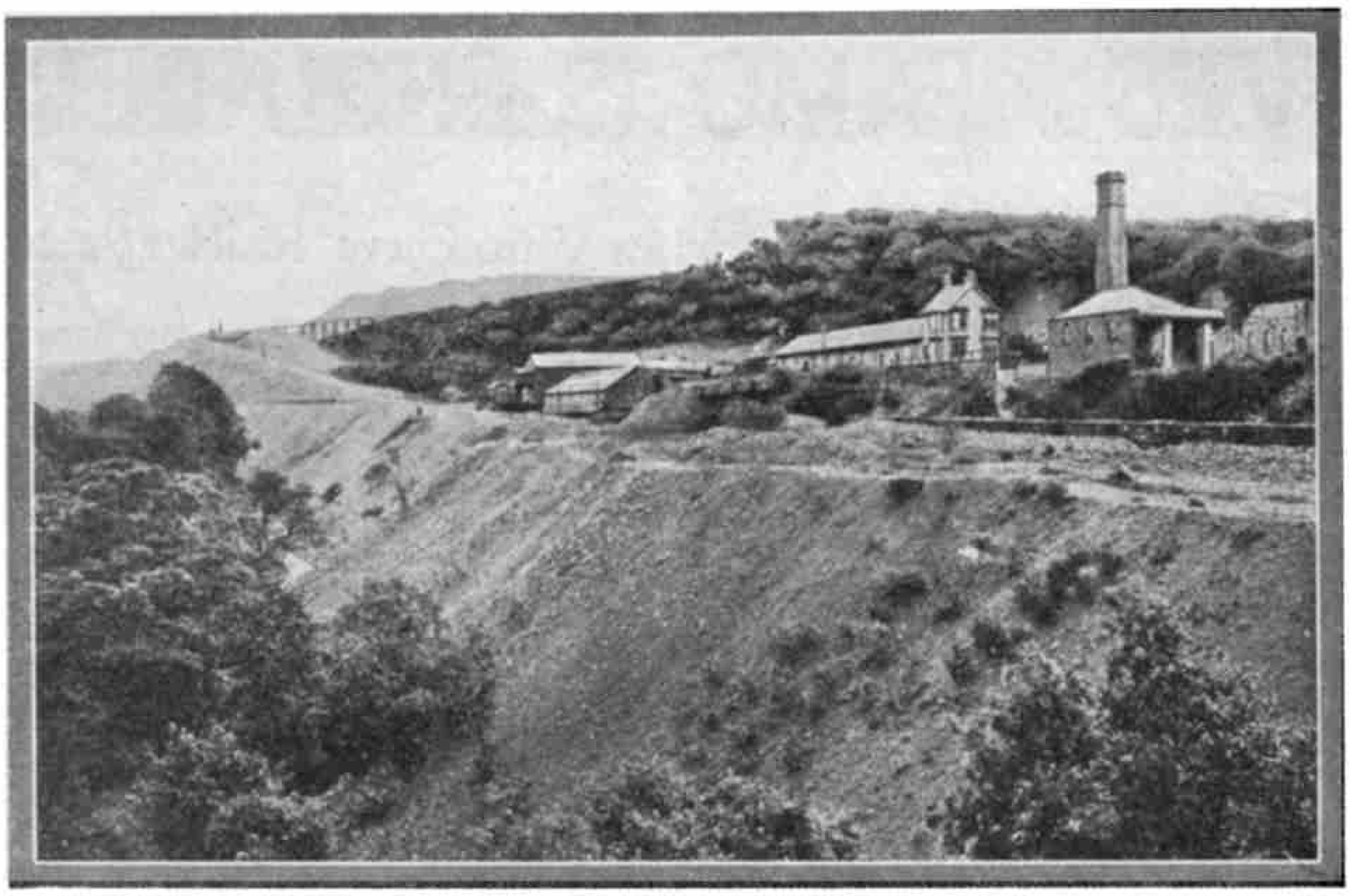
Iron Ore Mining

Iron ore is found in very many parts of the world, including Great Britain, Norway, Sweden, Spain, Germany, Russia and the United States. In some places the ore lies close to the surface of the earth; in others it lies deep down, and the method of getting it varies accordingly.

Some of the most striking examples of iron mining on a huge scale are to be found in the Lake Superior region of the United States, where ore of excellent quality occurs in enormous quantities in six ranges. The most important of these six, the rich Missabe range, extends for 112 miles. Its importance lies in the fact that the ore is found close to the surface and is obtained by a sort of quarrying operation known as "open-pit" mining. This is a considerably less expensive method than the mining with shaft and tunnel which becomes necessary to obtain the deeper-lying ore of the other ranges.

In open-pit mining the layer of earth overlying the ore is stripped off. This is a tremendous task, involving the removal of millions of tons of earth, which must be dumped on the nearest land having no ore below it, but the operations are assisted by giant steam shovels, as described in recent issues of the "*M.M.*" When the ore deposit is reached, the steam shovels are used to cut their way into it, and as they are capable of digging out a mass of ore weighing sixteen tons at every cut, they are of great assistance to the miners. The shovels make one cut every minute, so that they each handle 960 tons of material every hour, which is dumped into waiting trucks, thus speeding-up the work very considerably.

During about eight months of the year the shovels work without ceasing, day and night, and the amount of material they cut is almost incredible. Perhaps the most remarkable example of their work is at Hull Rust mine on the Missabe range, where they have excavated a gigantic hole over 300 ft. in depth, three-quarters of a mile wide, and 2¼ miles long! In 1916 this mine produced over seven-and-a-half million tons of ore.



Photograph] **An Iron-ore Mine** *[Messrs. Dorman, Long & Co. Ltd.*

NEXT MONTH:—

BLAST FURNACES:
Cast and Wrought Iron.

Interesting Paragraphs

New Niagara River Bridge

A new bridge is soon to be constructed over the Niagara River, near the Falls, by the American Bridge Company, of Philadelphia. The structure, which is to take the place of the present cantilever bridge, will be of the steel arch type, having a span of 640 ft. and a double rail-track.

* * * *

Motor Railway Engines in America

The Chicago Great Western Railway is making a significant addition to its rolling stock. Fifteen trains will shortly be provided with motor engines in consequence of results obtained with four trains so equipped for suburban service, which have been making a mileage of 100 to 150 a day. The trains are to be used in the thickly-populated district of Iowa.

Tempering of Steel Drills

A South African mining engineer, Mr. Donovan, has invented a furnace that enables drills to be re-heated for hardening purposes at the rate of 150 to 200 per hour. The invention is based on the principle that steel or iron when it reaches a certain temperature becomes de-magnetised and is no longer subject to the pull of a magnet. When the steel reaches the required temperature it is automatically withdrawn from the furnace and rings a bell as it comes out to warn the attendant that it has been sufficiently heated.

* * * *

Dr. W. H. Hatfield, of Sheffield University, states that four types of stainless steel are now produced, and that stainless steel has been used to make enormous turbine blades. It may be drawn so finely that hypodermic needles are now largely made from it.

IV. GEORGE STEPHENSON, the Man Who Gave Railways to the World.

THE conquest of Chat Moss, described in our last issue, was only one of many difficulties that Stephenson encountered in laying the line from Liverpool to Manchester. Remembering his motto, "Persevere," he surmounted them all, and nothing could turn him from the path that he had mapped out for himself and his work.

A Great Achievement

In practice, if he could not surmount obstacles he tunnelled beneath them, as in the case of the ridge of sandstone that threatened to prevent the line from Manchester reaching Liverpool. Through the great mass of rock at Olive Mount, Stephenson drove a cutting. The excavation of Olive Mount Cutting—which, by the way, is only a few minutes' walk from the Meccano factory—would be considered a formidable task, even to-day. In Stephenson's time, without skilled workmen or modern labour-saving devices, the achievement was all the more remarkable, and the work is undoubtedly one of the most wonderful engineering feats in history. The cutting extends over two miles through solid red sandstone. Nearly 500,000 cubic yards of rock were removed, and in places the walls in the cutting rise to a height of over 100 ft. Anyone who stands on one of the bridges that cross the cutting cannot help but pay tribute to the imagination of the man who conceived this great work and admire the perseverance and skill by which he carried his plans to a successful issue.

Stephenson's Good Example

The conquest of Olive Mount was not the end of Stephenson's troubles, however, for between the cutting and Liverpool is another ridge of rock through which it was necessary to cut a tunnel one-and-a-half miles in length. The excavation of this tunnel proved to be a matter of great difficulty, but in blasting and hewing the rock Stephenson's colliery experience was of great service. On several occasions water penetrated into the workings, and when wet sand was encountered it became necessary to prop and under-pin the roof.

On more than one occasion the workmen gave up work, refusing to continue with so dangerous a task. Stephenson was always ready to share danger with his men, however, and taking off his coat and picking up a spade he made his way into the workings. His good example immediately reflected itself upon his men and they followed him into the tunnel to continue with their task.

Trains Without Locos

So far we have dealt only with the civil engineering aspect of the Liverpool to Manchester railway, but we must now say a few words about the mechanical side. In these times we naturally associate locomotives with railway lines, but in the early days such an association would have been somewhat premature. In the case of the Liverpool and Manchester Railway it was not at first contemplated that many passengers would be carried. The original idea was to convey raw materials and merchandise between the two towns, and therefore the question of how the trains would be moved was not of such importance as it would have been had the railway been catering for passenger traffic alone.

The directors of the railway held several board meetings to discuss the form of power to be used. Some suggested that the trains should be hauled by ropes, actuated by a number of stationary steam engines placed at regular distances along the line. Others were in favour of employing horses to draw the wagons, as had been done in the early railways at the collieries in the north of England. Celebrated engineers, when asked to report on the matter, admitted that they had no confidence in the future of the locomotive. Some, indeed, would not even take the trouble to examine the details of the locomotives installed with success on the Stockton and Darlington Railway by Stephenson.

In giving their opinion these engineers were probably actuated by jealousy, which no doubt arose from the fact that professional engineers did not favour the idea of a one-time engineman appearing before Parliament in the rôle of a leading engineer in support of the Railway Bill. As it was, the directors could get nothing but contradictory opinions from the experts, and these did not help them to come to a final decision.

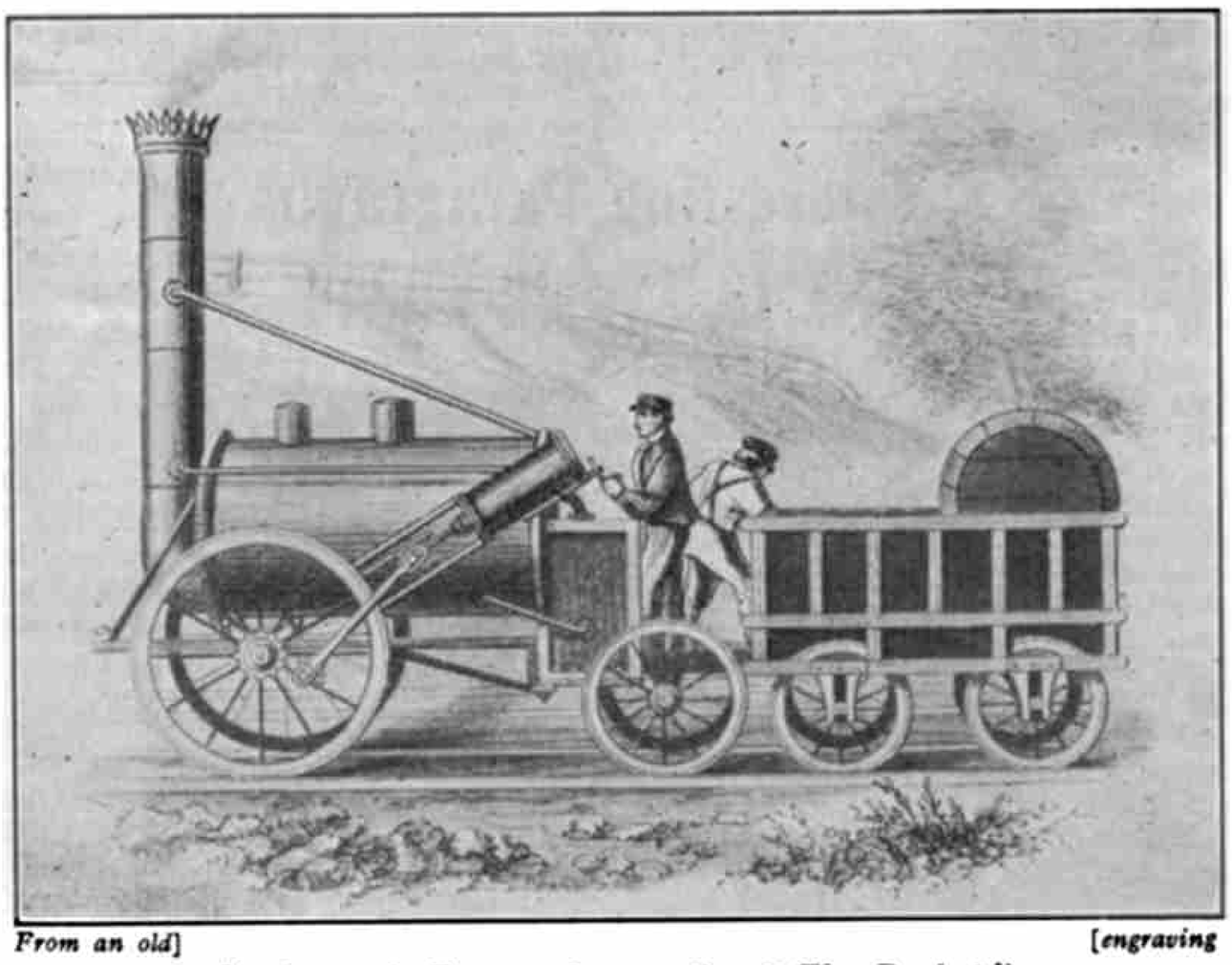
Stephenson Favours the Loco

Stephenson himself had not the slightest doubt on the question of the type of power that he considered would be the most satisfactory. He persevered in advocating that locomotives should be employed on the new railway. He had scarcely any supporters, and both the engineering profession and public opinion were dead against him. This did not deviate him from his purpose, however, and his persistent earnestness and his arguments at last had their effect.

The directors determined to stimulate enterprise by offering a reward of £500 for the locomotive that most satisfactorily performed certain tests, one of which included the maintainance of a speed of ten miles an hour.

The Famous "*Rocket*"

Stephenson's son, Robert, whose life we shall deal with at greater length in one of our future instalments, had recently returned from South America, and both father and son determined to build a locomotive for the competition. Together they produced the "*Rocket*," a name that became famous, for this engine was destined to make history. The "*Rocket*" included many improvements upon Stephenson's earlier engines, and when finished



From an old engraving

Stephenson's Famous Locomotive "*The Rocket*"

underwent a trial on the lines at Stephenson's old work-place, the colliery at Killingworth, near Newcastle. The "*Rocket*" was equipped with a steam blast, and a cylindrical boiler six feet in length, with 25 copper tubes each three inches in diameter. These tubes were surrounded by the water of the boiler, the heated air passing through them on its way to the chimney. The fire-box, immediately behind the boiler, was surrounded by water, and the cylinders were placed obliquely on each side of the boiler with the piston rods connected directly to the cranks on the front wheels. The tender carried a water cask as well as a supply of fuel, and engine and tender and load of water weighed only 4¼ tons. The initial tests proved satisfactory, and the "*Rocket*" was taken to Carlisle and shipped to Liverpool, to await the great day.

The £500 Competition

The official trials were to be held at Rainhill, a village a few miles east of Liverpool, and as the date of the contest drew near there was great excitement. Engineers, scientists, and mechanics from all parts of the country arrived to witness the event on which such great results depended. The ground was thronged with thousands of spectators, all wildly excited, and horses and carriages were drawn up alongside the track.

The following engines were entered in the competition:—"*Novelty*" (constructed by Braithwaite and Ericsson); "*Sanspareil*" (Hackworth); "*Rocket*" (Stephenson); "*Perseverance*" (Burstall) and "*Cycloped*" (Brandreth). Several other engines had been constructed in different parts of the country, but they were not ready in time and consequently did not appear.

Unsuccessful Competitors

The trials remind one of the story of the "Ten Little Nigger Boys." By the conditions of the contest each engine was to make 20 journeys over two miles of railroad at a speed of ten miles an hour. One by one the competitors were accounted for and retired from the field, leaving Stephenson's "*Rocket*" the victor.

Even before the competition began, the "*Cycloped*" was disqualified, and we are able to imagine how the Stephensons must have smiled to themselves when it was found that instead of the loco being driven by a steam engine it depended for its motive power on a horse in a frame—a kind of "squirrel-wheel" or tread mill!

The four remaining engines made preparations to get up steam, and with their usual thoroughness, the Stephensons had their engine ready first. It was by no means a favourite, however, but as it was ready it was ordered out for an experimental trip, which it performed satisfactorily. On the following day the bellows that forced air through the furnace of the "*Novelty*" gave way, even before the judges arrived on the ground, and the "*Novelty*" retired. The "*Sanspareil*" was equally unlucky, for a defect developed in its boiler.

George Stephenson

From a painting by H. W. Pickersgill, R.A., in the National Gallery)

In the meantime the Stephensons again brought out the "*Rocket*," and with 30 passengers it travelled along the line at a speed of 30 miles an hour, to the amazement of the spectators. The "*Rocket*" was tried again on the third day, steam being raised from cold to a pressure of 50 lb. to the square inch in just under an hour. A weight of 13 tons was hauled backwards and forwards for a total distance of 35 miles in a period of one hour 48 minutes, including stoppages.

The Victorious "*Rocket*"

In the meantime the "*Novelty*" had been patched up and was again tried on October 10, but soon after commencing to run she burst a pipe from the forcing pump. The "*Sanspareil*" had also been repaired, but now she was found to be 4 cwt. over the weight limit. The judges allowed her to run, however, but before she had completed eight journeys her water pump went wrong and she came to a standstill.

While all this was taking place the engineers in charge of the "*Perseverance*" had been using strenuous efforts to get their engine into working order, but they had been unsuccessful in getting it to move at more than five miles an hour and so it was withdrawn from the competition. On the following day, when the result was to be announced, Braithwaite and Ericsson pleaded hard for another trial for the "*Novelty*," but on this being granted they had no better luck, for the engine broke down again.

There was now only the "*Rocket*" left in the competition, and as it had more than conformed to all the stipulated conditions the Stephensons were accordingly awarded the prize of £500 and, naturally, both father and son were delighted. The competition had a far wider importance than the triumph of the "*Rocket*" over its competitors; it established the efficiency of the locomotive for all future railways, and showed that a new power had arrived. The turning point of this vital matter was Stephenson's combination of the steam blast and the multi-tubular boiler.

We have not space in which to deal at length with the many other activites and achievements of George Stephenson, and must close our article on this great man with but a brief reference to his later years.

Stephenson was afterwards associated, along with his son, Robert, in the building of many other railways, for they were now recognised as the leading railway engineers in England. George Stephenson's life was an extremely busy one at this period, for in addition to his railway undertakings he took a leading part in coal-mining developments in the Chesterfield district. In order to be near these mines he removed to Tapton House, near Chesterfield, and this became his home for the remainder of his life.

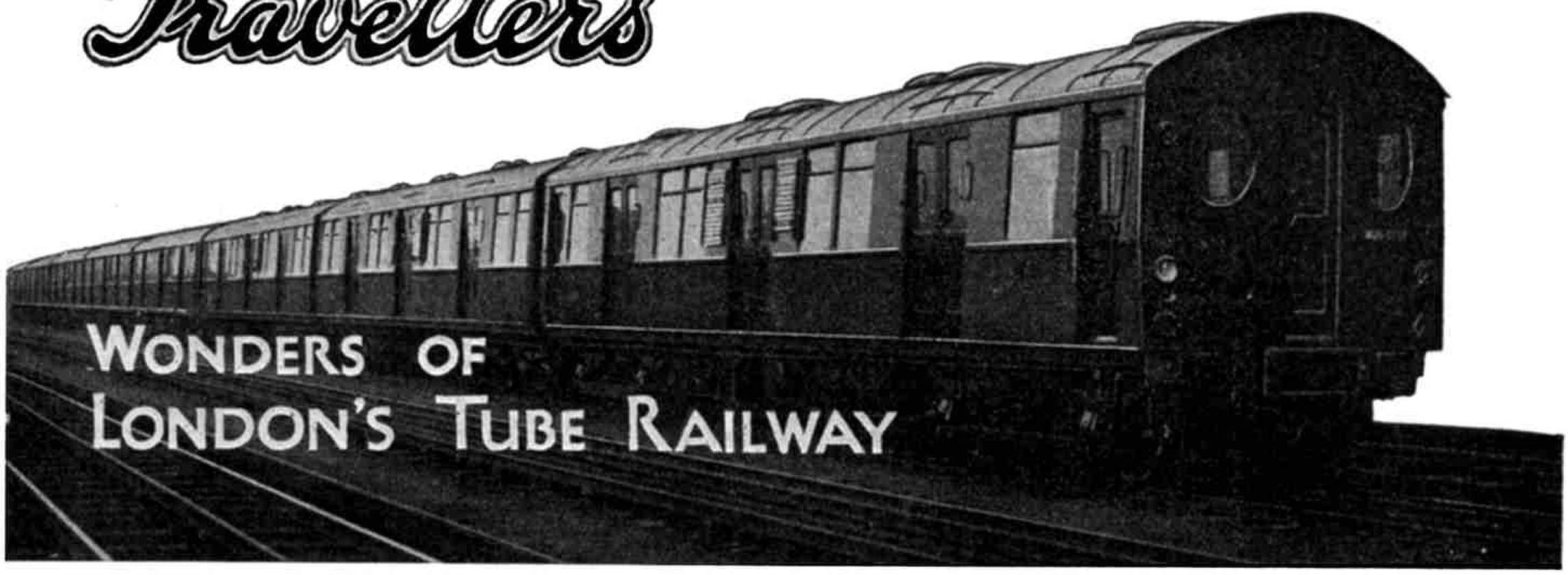
In 1840 he announced his intention of withdrawing from further professional work, as he felt the need of rest. From this time he lived quietly and peacefully at Tapton until his death in August 1848, at the age of 66. It is pleasing to find that in his later years this great man, one of the greatest engineers the world has known, found his chief pleasure in walking in the country lanes around his home. It was his delight to study Nature and more particularly birds and their nests, a habit that he had acquired during his youth when whiling away his time, keeping the cows off the colliery rail-road.

(THE END)

Photograph by courtesy of [*Newcastle Chronicle*

Monument to George Stephenson at Newcastle-on-Tyne

Millions of Underground Travellers



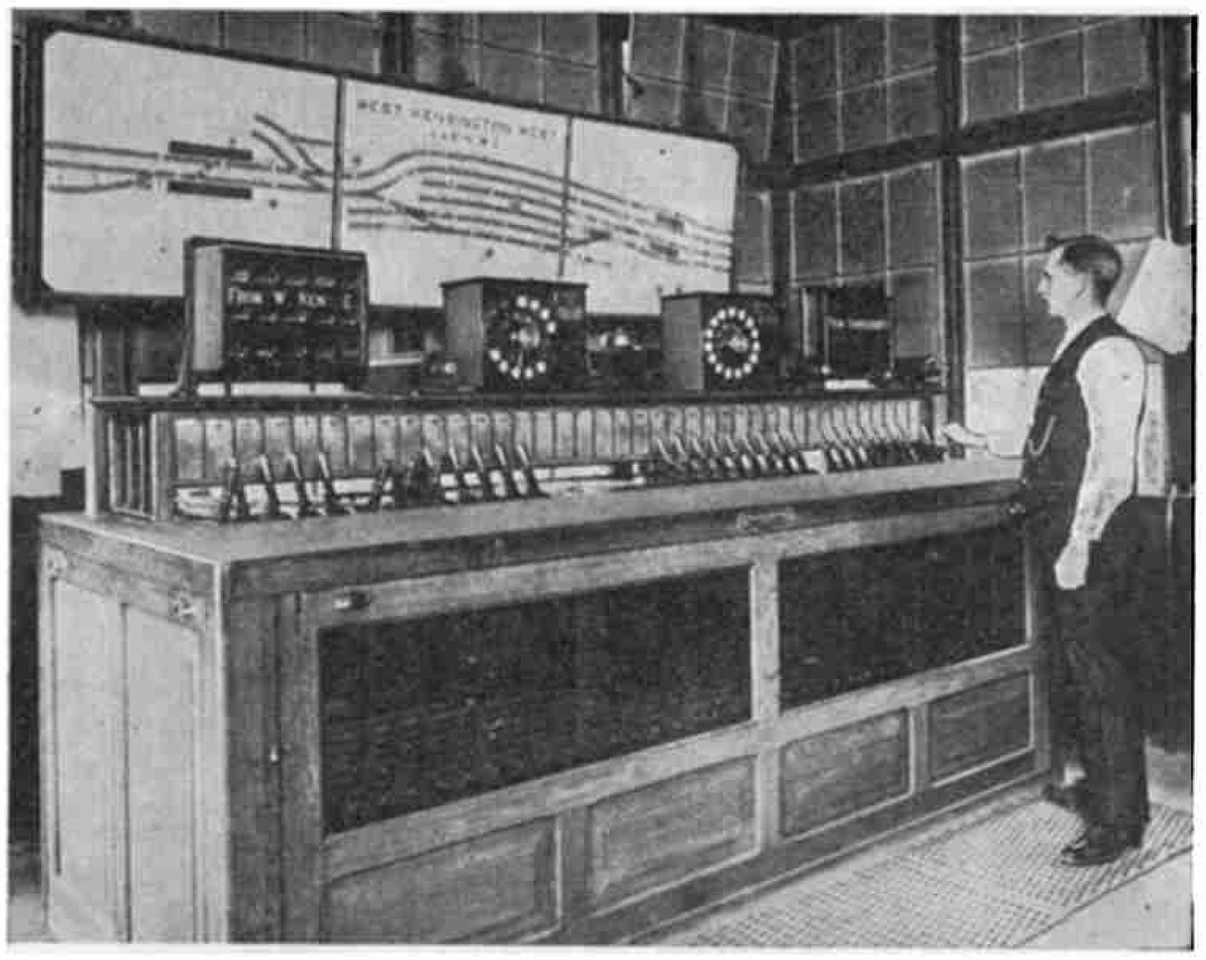
The working of the London Underground Railways differs in many respects from that of ordinary surface railways. In this connection perhaps the most noticeable feature is the great amount of work done by wonderful automatic devices. In our last issue we described the Passimeter—a machine that is almost human—and those wonderful time savers, the travelling staircases. In the concluding instalment below we describe some even more remarkable devices for saving time and labour.

FROM the roof of the Tube stations are suspended large signs, one of which was shown last month in the illustration of Charing Cross Tube Station. Normally each sign is blank, but shortly before a train is due the sign lights up from the inside and the destination of the train is shown in illuminated white letters. Some signs show the destination of the next three trains.

Time-Saving Indicators

As each train passes out of the station the illuminated names on the sign disappear, their place being taken by new names showing the destination of the next train. These electric indicators are operated from the signal cabins, and save a great deal of time and confusion. They need no explanation, as their meaning is plain even to strangers to London, and they make it unnecessary for passengers to worry the station officials, who have quite enough to do without answering innumerable questions.

Another type of electric indicator is shown at the foot of the next page. In this type the names of the various stations on the line are permanently on view and the trains' destinations are indicated by illuminated numbers, which appear and disappear on the board as the trains arrive and depart. In our illustration the indicator shows that the first train to arrive will be an Inner Circle train, the next train to Bow Road, and the next one to Barking. Immediately the Inner Circle train has come and gone, the figures will rearrange themselves. Figure 1 will appear opposite Bow Road, figure 2 opposite Barking, and figure 3 opposite the destination of the train following that to Barking.



The Signal Cabin at West Kensington, showing electro-pneumatically operated signals. Note how in this system the familiar cumbersome levers are replaced by the miniature levers here shown.

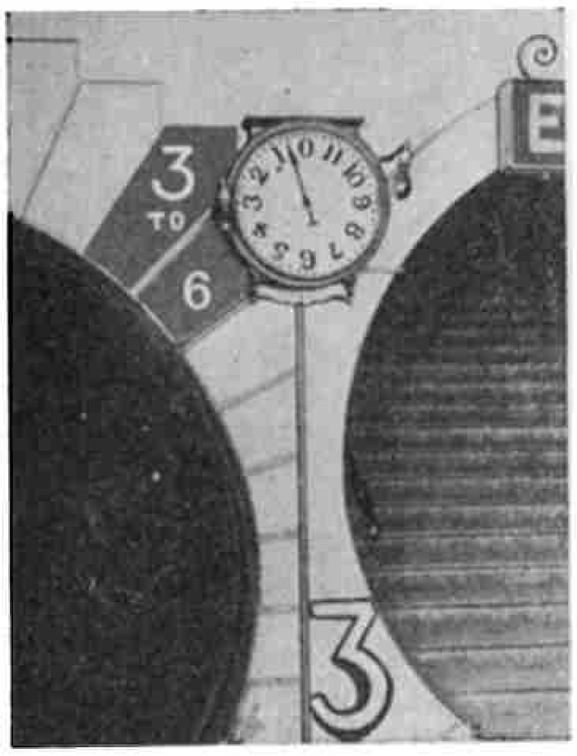
An Ingenious Clock

At the end of each Tube platform is a "Headway Clock," illustrated on the top left of the next page. This clock has only one hand, and this moves in the opposite direction to that of the hands of an ordinary clock. The hand shows in minutes and seconds the interval of time between the train in front and its successor. During the rush hours, when business people are all hurrying home after their day's work, there may be as many as forty trains on one line in an hour. At such periods it is very necessary that the trains shall keep exact time, so that they do not over-run their sections and approach each other too closely.

The headway clock indicates clearly to the driver of each train his position in regard to the train in front, and it also shows him at a glance whether or not he is behind or in advance of his scheduled time. This very ingenious device also makes a permanent record on paper of the progress of each train, and the time it departs from the station, so that the driver's time sheet may be examined and checked off later.

In Case of Accident

Another safety device is the special telephone, with which the driver of any train is able to communicate with the nearest



The Headway Clock

station without leaving his cab, in case of accident. He does this by connecting the instrument to a pair of wires that run along the tunnel walls. These wires also serve another purpose, for by connecting them together power is instantly cut off from the conductor rail, and the tunnels are illuminated by a special emergency lighting circuit.

Thus, should the train break down in a tunnel, the driver is able to illuminate the tunnel to enable the passengers to walk through to the nearest station, at the same time ensuring their safety from electrocution by cutting off the current in the third rail. He is also able to telephone to the nearest station to report the breakdown and state his exact position, so that assistance may be sent at once.

Automatic Signalling

With so many trains on the track we are easily able to understand that signalling on the Tube is of even greater importance than on an ordinary railway. In many instances, however, the duties of the signalmen are made lighter by automatic devices. In passing a signal, a train immediately sets it at danger, in which position it remains until the train has passed into the next-section-but-one of the line.

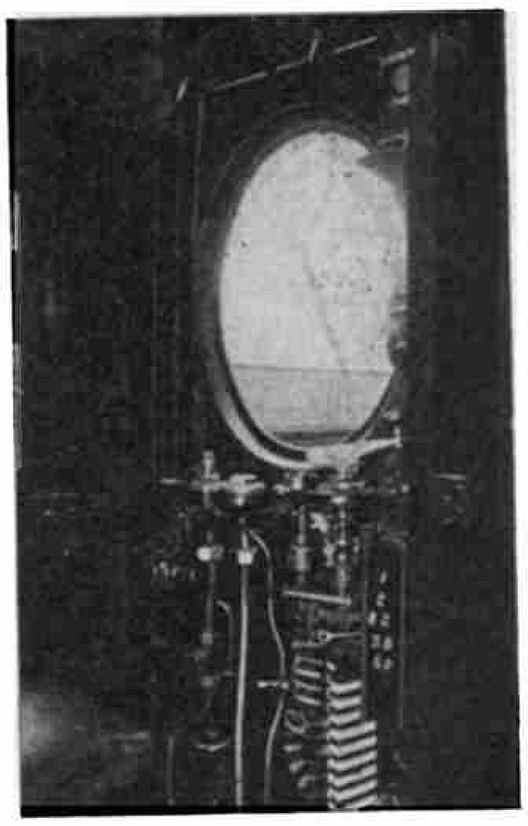
In addition to this automatic signalling, there are signal cabins to control junctions and certain sections of the line. The illustration at the foot of the previous page shows the cabin at West Kensington, and our readers will at once notice the absence of the long levers, generally associated with a signal box. Instead, miniature levers electrically operate the pneumatic signalling apparatus. At the same time the signalman has in front of him a map of the section under his control, and an ingenious arrangement illuminates that portion of the line on which a train is travelling. The signalman is thus able to see at a glance the exact position of any train in his section.

The signalmen are very carefully trained in the specialised duties they have to perform. They attend lectures and special film displays, and are required to pass through several examinations before being allowed to take charge of a signal cabin.

One Man Controls over 2,300 h.p.

The "make-up" of Tube trains differs according to requirements, but the usual train consists of about eight coaches. Instead of having the motive power at the front, as in ordinary railway practice, the power is distributed over the length of the train, in order to give smooth starting and rapid acceleration. The cars containing the electric motors devote only a comparatively small portion of their space to the motor.

The horse-power required to drive a train is considerable. For example, our heading shows a train in which there are twelve motors, each of 195 h.p., giving a total of 2,340 h.p. This enormous power is entirely under the control of the driver, and in order that the safety of the train may be ensured, control is effected through a device shown in the accompanying illustration. This is known as the "dead-man's handle," and consists of a knob at the top of the controller that regulates the supply of current to the motors. The knob must remain depressed during the whole time that the motors are running. If the pressure is relaxed, even for a second, the current is automatically cut off and the brakes are applied. Thus, should a driver be taken ill at his post, or have a sudden seizure, the train is prevented from running away, and disaster is averted.

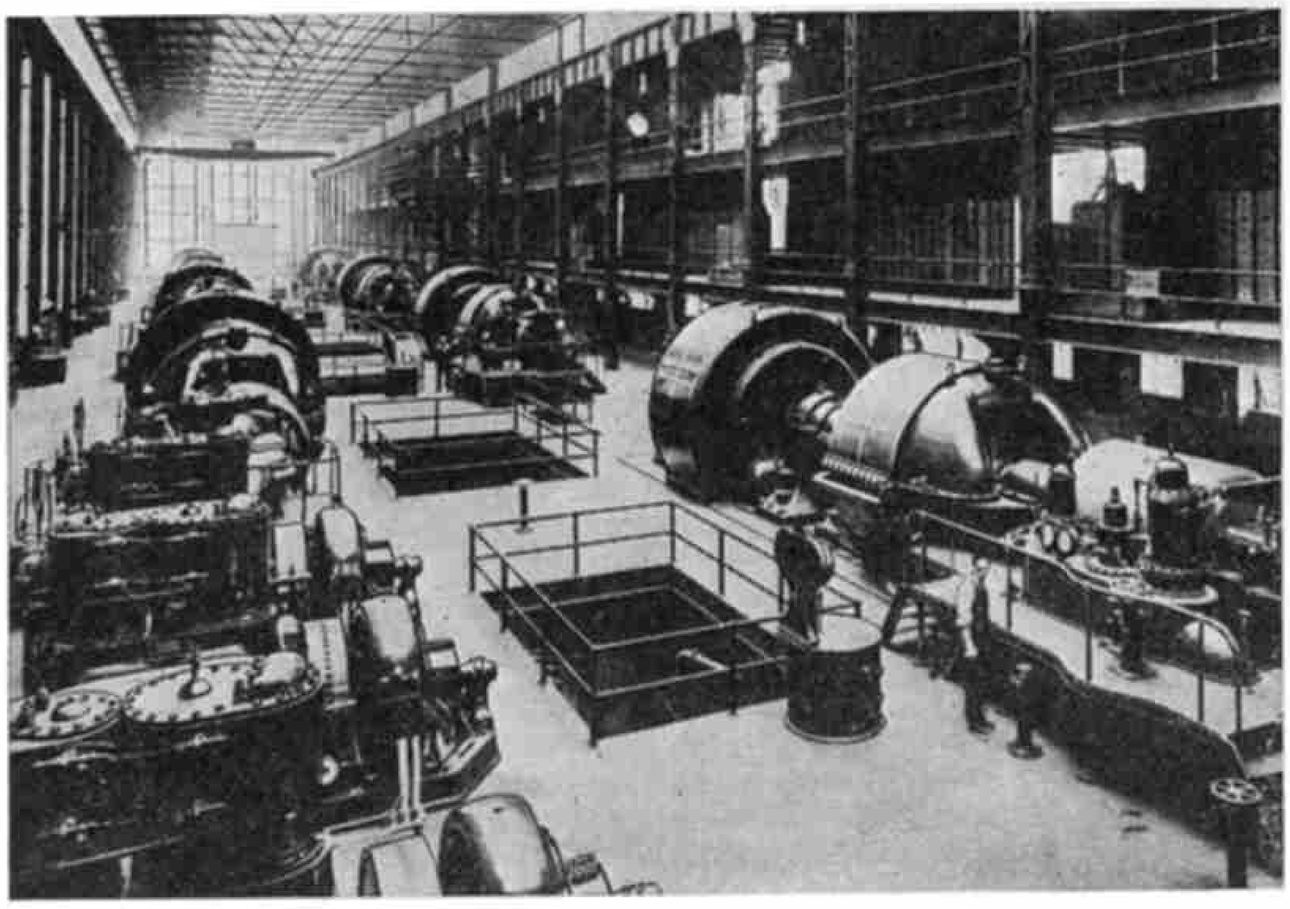


The "Dead Man's Handle"

For Absent-Minded Drivers

The "dead-man's handle" covers only one danger—that of the driver falling ill at his post. It does not eliminate absent-mindedness, which might cause an accident through a train being allowed to run past a signal set at danger. To guard against this eventuality there is a safety device called the "Trip-Cock," which automatically brings to a standstill a train that over-runs a signal. The trip-cock works in conjunction with the signal, and consists of an arm which, when the device is in action, strikes another arm on the train, instantly applying the brakes throughout the whole length of the train.

So efficient is this device that a train at full speed is brought to a standstill within its own length!

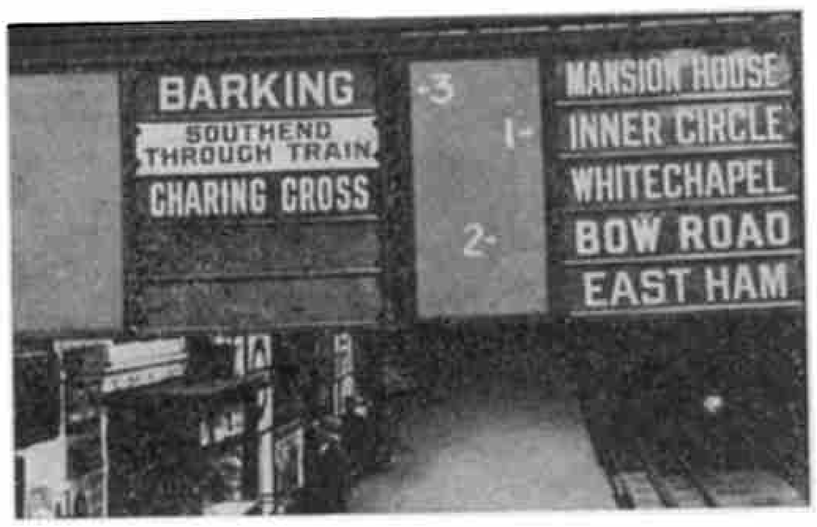


Turbo-Generators at Lots Road Power Station, Chelsea

The Power House

As is only to be expected, enormous power is required to operate London's underground railways. This power is derived from the huge generating station at Lots Road, Chelsea. This power house, one of the largest in the world, is very conspicuous on Thames-side by reason of its four great chimneys. Here, giant steam turbines, running at some 2,000 revolutions a minute and developing over 100,000 h.p., drive the dynamos that generate electric current at a pressure of 11,000 volts. A noticeable feature about turbo-generators, as these turbine-driven dynamos are called, is their smooth and silent running. So smoothly do they run indeed, that anyone watching these softly purring monsters finds it difficult to realise that they are generating power to move millions of underground travellers.

Over 700 tons of coal are required each day to feed the furnaces of the 68 boilers generating steam for the turbines. This coal comes up the Thames in barges, which are unloaded by electrically-operated gantry cranes. The coal is stored in enormous bunkers, one of which is capable of holding 8,000 tons.



Electric Platform Indicator

The Tragedy of a Snowball

To look at this gigantic power house, whether from the outside or the inside, one would think that nothing short of an earthquake could upset its operations. Yet it was once completely thrown out of its stride by a very trivial incident. One Christmas time a small boy threw a snowball through a window

(*Continued on page* 134)

BUILD YOUR OUTFIT INTO A No. 7

WITH

MECCANO

ACCESSORY OUTFITS

For convenience, Meccano parts are sold in nine Outfits of varying size, numbered 00 to 7. The quality and finish of the parts are of the same high standard throughout the series, but as the Outfits increase in size they contain larger quantities and greater varieties of parts. Each Outfit may be converted into the one next higher by the purchase of an Accessory Outfit. Thus, if a No. 2 is the first Outfit bought, it may be converted into a No. 3 by adding to it a No. 2a. A No. 3a would then convert it into a No. 4, and so on up to No. 7. In this way, no matter with what Outfit you commence, you may build up by degrees to a No. 7 and so be able to make *all* the many hundreds of models shown in the Books of Instructions.

PRICE LIST

Complete Outfits

No. 00	3/6
No. 0	5/-
No. 1	8/6
No. 2	15/-
No. 3	22/6
No. 4	40/-
No. 5 (In well-made carton)	55/-
No. 5 (In superior oak cabinet with lock & key)	85/-
No. 6 (In well-made carton)	105/-
No. 6 (In superior oak cabinet with lock & key)	140/-
No. 7 (In superior oak cabinet with lock & key)	370/-

No. 7 Outfit. Builds all the models in the Complete Manual, and many others. Packed in beautifully-finished oak cabinet with lock and key.

PRICE LIST

Accessory Outfits

No. 00a	1/6
No. 0a	4/-
No. 1a	7/6
No. 2a	8/6
No. 3a	18/6
No. 4a	15/-
No. 5a (carton) ..	50/-
No. 5a (wood) ..	80/-
No. 6a	210/-

MAKE YOUR OUTFIT BIGGER AND BETTER

No. 6 Outfit. Builds 360 models. No. 6a, costing 210/-, converts this Outfit into a No. 7 Outfit, with which all the models in the Complete Manual may be built.

PURCHASE AN ACCESSORY OUTFIT

Meccano Ltd.

BINNS ROAD

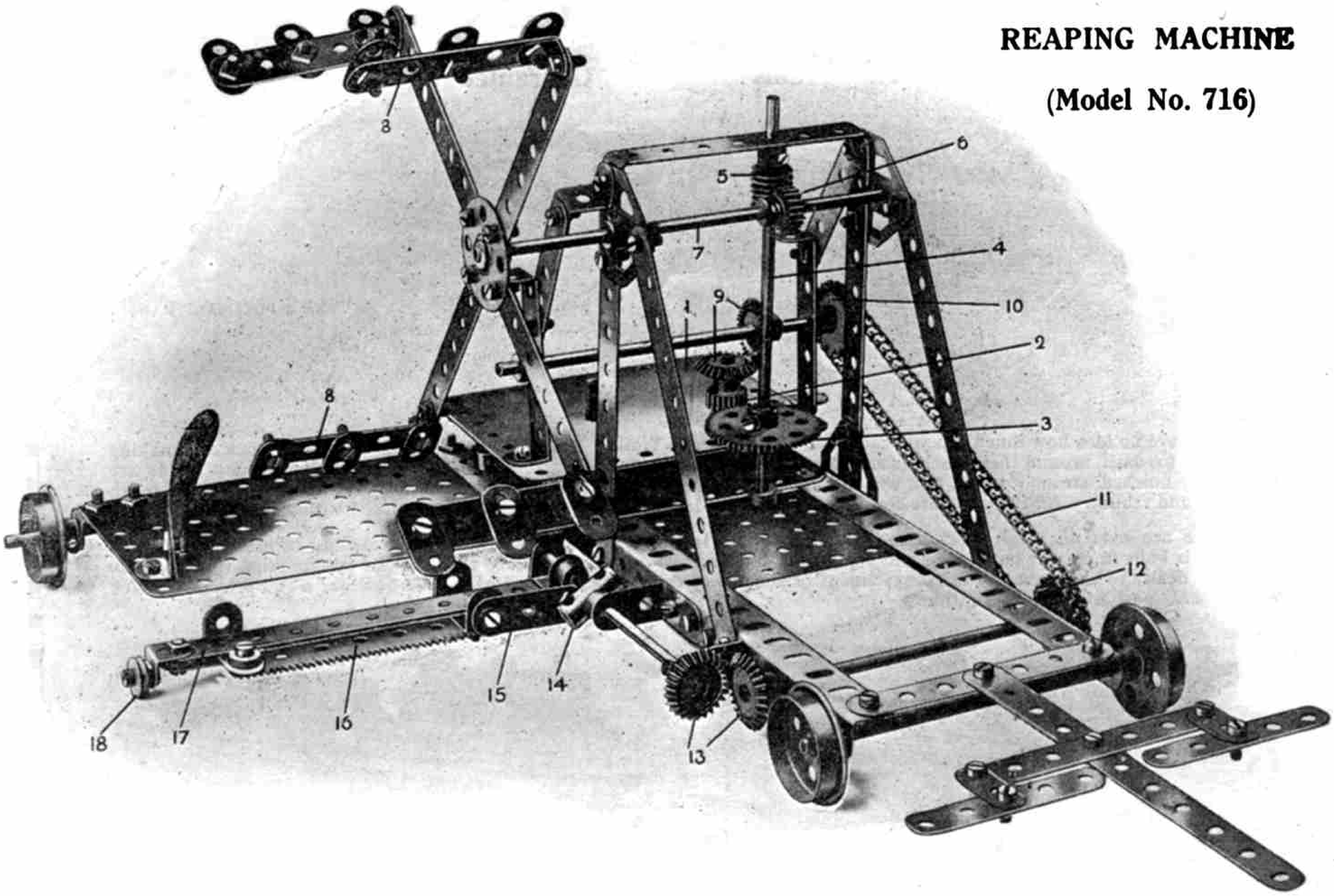
LIVERPOOL

Accessory Outfits are obtainable from all Meccano Dealers.

A NEW MECCANO MODEL

REAPING MACHINE

(Model No. 716)



This new Meccano model of a Mowing and Reaping Machine is specially interesting, not only as a model but also as a reminder of the progress made in methods of reaping since the days of the sickle and the scythe. Great advances have been made in recent years, and it is a far cry from Bell's first reaper to the giant steam-harvesters of to-day.

FROM very early times up to the 19th century the sickle provided the only means of reaping corn. The reaper grasped a number of stalks with one hand, and cut through them close to the ground with a sweep of his sickle. From a modern point of view this process was ridiculously slow. Considerable improvement was effected when the scythe supplanted the sickle, for this implement enabled a man to mow at least ten times as much grain in a day as was possible with the sickle. To-day, however, neither sickle nor scythe take any part in reaping operations, except on a very small scale. Their place has been taken by wonderful machines that have made possible the cultivation and reaping of the great grain fields of the world.

First Reaping Machines

The first reaping machine was invented about 1831 by a Scotsman, the Rev. Patrick Bell, of Carmylie, Forfarshire, and his original machine is now in the South Kensington Museum. Bell's reaper was quickly followed by two others, the inventions respectively of Obed Hussey and Cyrus W. McCormick, both Americans.

The cutting arrangements in these American machines worked on the principle of a reciprocating sickle, and consisted of a set of saw blades oscillating backward and forward through slots in toothed pieces of metal fixed at intervals along a horizontal bar. The action is practically the same as that of a pair of scissors having one blade fixed and the other free to move.

In order to prevent the corn from falling in front of the blades after it was cut, McCormick patented (in 1834) a device known as a "reel." The reel is still in use, and on modern machines consists of a round frame with horizontal slats so distributed that, as the reel rotates, they bend over the corn in front of the sickle at the instant of cutting, thus causing the cut stalks to fall behind the blades.

One of the great difficulties that faced the early inventors was the removal of the cut stalks from the track of the sickle, for if they remained where they fell they would be trodden upon by the horses when the next swath was cut. In Bell's machine this difficulty was overcome by a kind of canvas apron travelling constantly over rollers, which deposited the cut stalks in safety on one side of the machine. This travelling apron is still in use on modern machines.

Machine Binds Its Own Bundles

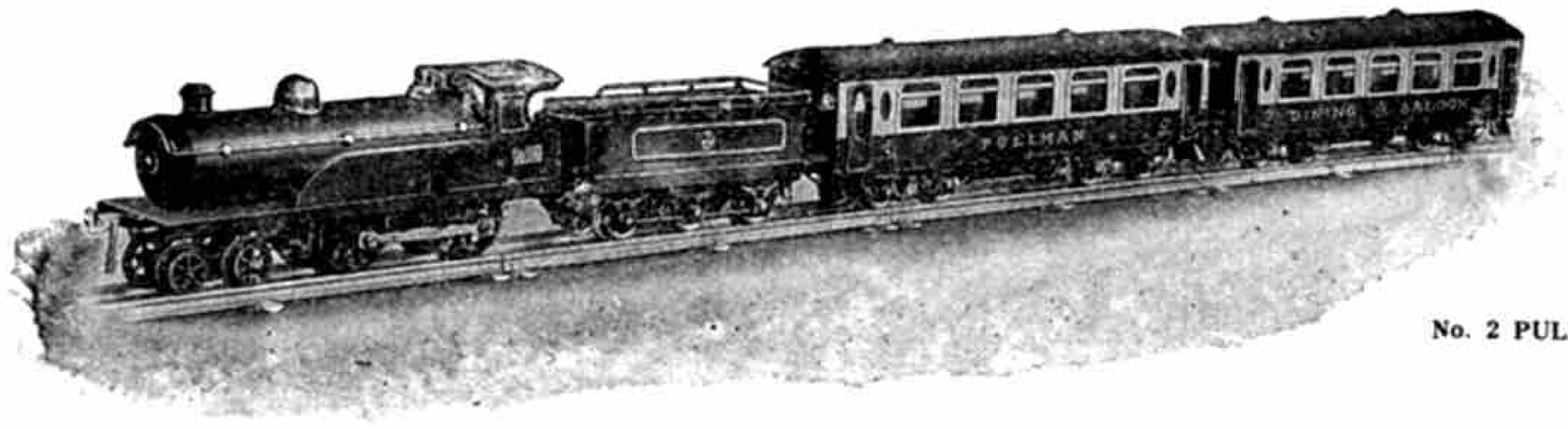
Reaping machines were later improved by the addition of a platform upon which men could stand and bind the cut corn into bundles as they received it from the travelling apron, instead of having to walk behind the reaper to do the binding. This improvement saved a great deal of time, but it was superseded about 1873 by a machine that did its own binding. At first wire was used for tying bundles, but it was quickly found that it was not

(*Continued on page* 123

FOR YOUR NEXT BIRTHDAY PRESENT CHOOSE

HORNBY CLOCK WORK TRAINS

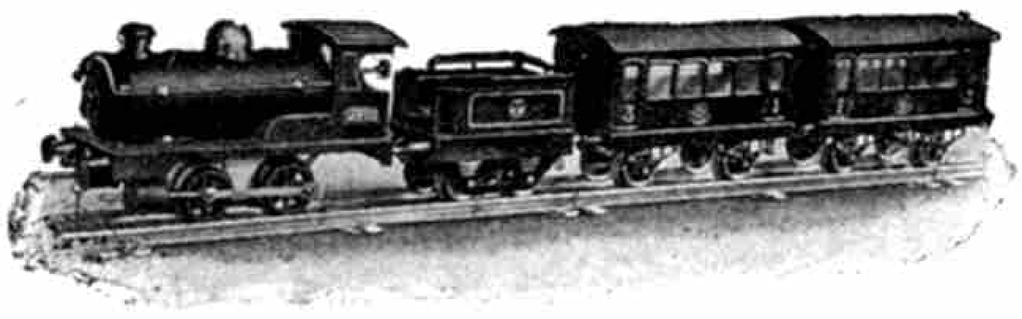
The Trains with the Guarantee



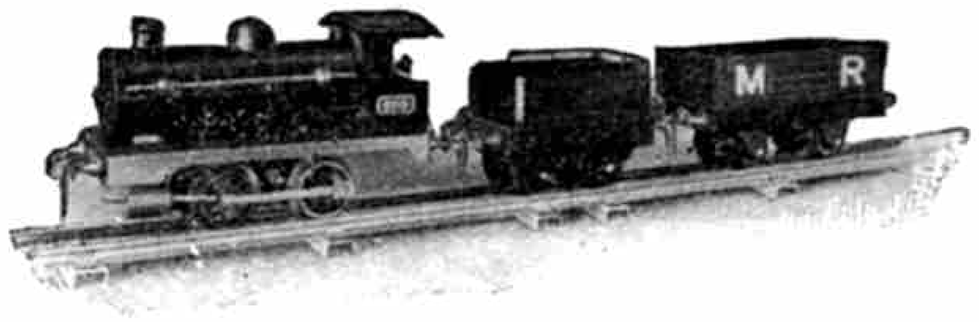
No. 2 PULLMAN TRAIN

You have no idea how much fun you can have with a Hornby Train. Shunting, coupling-up the rolling stock and making up trains to dash around their track as realistically as the real thing, will give you hours of pleasure. Hornby Trains are beautifully finished, strongly made, and will last for ever. One of their most remarkable features is that they may be taken to pieces and rebuilt. All the parts are standardised and any lost or damaged part may be replaced with a new one.

There are over 40 train accessories—stations, signals, lamps, a variety of wagons, level-crossings, turntables, etc., each of which is built in correct proportion and beautifully finished. New accessories are added to the system from time to time. Ask your dealer to show you the latest specimens or send to Meccano Ltd., Binns Road, Liverpool, for a full price list which will be sent (post free) on application.



No. 1 PASSENGER TRAIN



No. 1 GOODS TRAIN

HORNBY TRAIN PRICES

No. 1						No. 2					
Goods Set	...	...	25/6	Wagons	... ... each	3/9	Goods Set	... ...	45/-	Wagons	... ... each 3/9
Passenger Set	...	...	35/-	Tenders	... ... ,,	3/6	No. 2 Pullman Set	...	70/-	Tenders	... ... ,, 4/-
Locos	...	... each	16/-	Passenger Coaches	,,	6/6	Locos	... ... each	30/-	Pullman Cars	... ,, 16/-

HORNBY TANK LOCOS

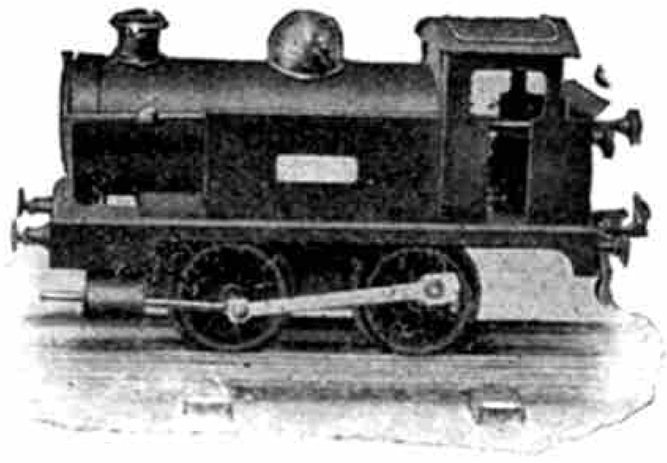
No. 2

The Hornby No. 2 Tank Loco is a powerful model embodying all the characteristics of the Hornby Train. It is 11¼" in length and is fitted at both ends with a special bogey. Beautifully finished in colours; lettered L.M.S. and L.N.E.R., with reversing gear, brake and governor. Suitable for 2 ft. radius rails only.

Price 32/6

Guarantee

Hornby and Zulu Trains are tested, and their efficiency is guaranteed. A form of guarantee is furnished with each loco, and we undertake to repair, or replace at our option any loco that fails to run satisfactorily from any cause other than misuse, within 60 days of purchase.



No. 1

The Hornby Tank Loco No. 1 is a strong and durable loco capable of any amount of hard work; richly enamelled and highly finished; fitted with reversing gear, brake and governor.

Gauge 0, in black only 12/6

FROM ALL MECCANO DEALERS

New Meccano Models (*cont. from page* 121)

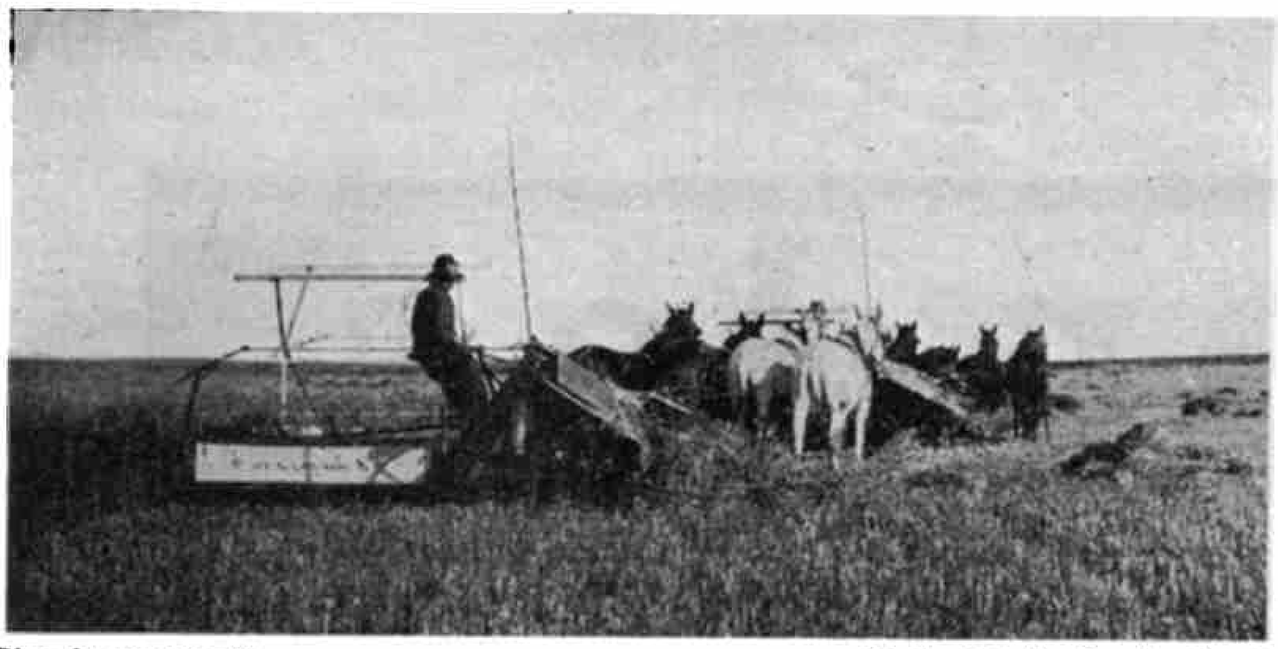


Photo by courtesy of [*Supt. of Emigration for Canada*

A Reaper at Work in Canada

satisfactory. Small pieces of wire became mixed with the threshed grain, and even with the flour, giving rise to serious possibilities. Hemp twine was then substituted for wire, with excellent results.

A modern self-binder cuts the corn, picks up a bundle of it, passes a cord around it and ties the cord with a knot, finally depositing the finished bundle either on the ground or on a platform on the machine. All this is done automatically, and the mechanism requires no attention.

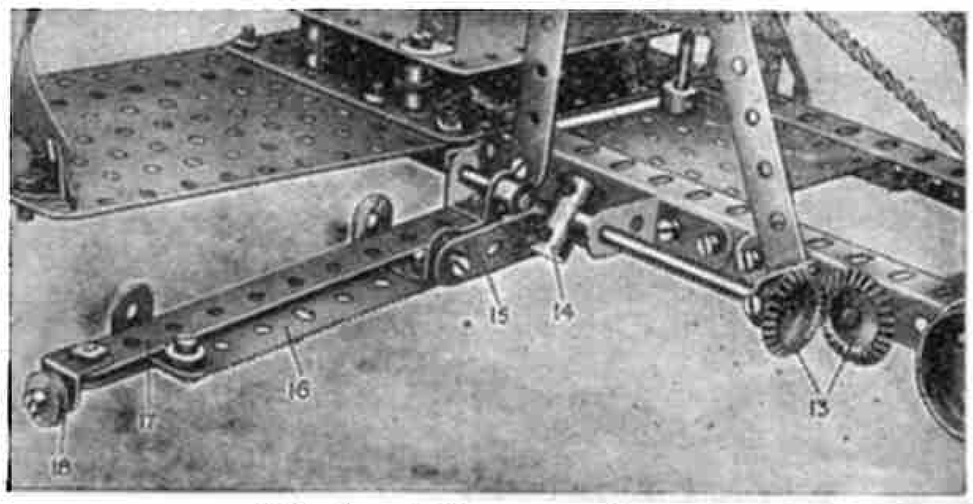
Wonderful Steam Harvesters

After being cut, the corn has to be passed through a process called threshing, by which the grain is separated from chaff and straw. Formerly threshing consisted of beating the ears with an implement called a flail, and this method is often mentioned in the Bible. Threshing in this manner was very slow, however, and was quite useless for harvesting on a big scale, and so threshing machines came to be invented. The first really practical machine was that of a Scottish machinist, Andrew Meikle, produced about 1813, and soon improvements were added until the wonderful machines of to-day were evolved. The early threshing machines were worked by teams of horses, but later steam power was utilised with greatly improved results.

It was found that the vast harvesting operations of Canada and the United States could be still further speeded up by combining the processes of reaping and threshing. This is done by means of a "steam-harvester." A traction engine takes the place of horses, the grain is cut but not bound into bundles, and a travelling apron carries it to the threshing mechanism. The whole process is thus automatic and continuous.

The Meccano Reaper

The illustration on the previous page shows a Meccano model (No. 716) of a Reaping Machine, which may be constructed with the assistance of the following details. The spindle of the Meccano clockwork motor (1) carries a pinion (2) engaging a gear wheel (3) on the rod (4) at the top of this rod (4) is a worm (5) driving a ½" pinion (6) on a rod (7) which carried the arms (8) that sweep towards the knife.



Details of Meccano Reaper

The driving spindle of the motor also drives through bevel pinions (9) a 1" sprocket wheel (10) coupled by a chain (11) to another 1" sprocket wheel (12) which in turn drives through bevel wheels (13) a coupling (14). This coupling acts as a crank and is connected by 1" strip lock-nutted (15) to the cutter (16). The cutter is formed by a rack strip guided to and fro by two 1" × ½" angle brackets between two 5½" strips (17) spaced apart by washers at each end. The outer end of these strips is fitted with a ½" pulley (18) on which the cutter knife travels. The remainder of the detail of the model will be made quite clear from our illustration. When completed the model works in a very realistic manner.

This model may be made with a No. 7 Outfit, but those who have a No. 4 or No. 5 Outfit will be able to build it with the addition of certain extra parts. The following is a full list of parts required.

Parts required for construction of Meccano Reaper (Model 716) :

7	of No.	2	2	of No.	12a	4	of No.	20	8	of No.	37a
6	,, ,,	3	4	,, ,,	12b	1	,, ,,	23	6	,, ,,	38
8	,, ,,	5	1	,, ,,	13	1	,, ,,	24	1	,, ,,	41
1	,, ,,	6a	2	,, ,,	14	2	,, ,,	26	1	,, ,,	48
2	,, ,,	8a	2	,, ,,	15	1	,, ,,	27a	2	,, ,,	48a
14	,, ,,	10	1	,, ,,	15a	4	,, ,,	30	1	,, ,,	48b
1	,, ,,	11	2	,, ,,	16b	1	,, ,,	32	1	,, ,,	52a
7	,, ,,	12	1	,, ,,	17	58	,, ,,	37	1	,, ,,	83

7	of No.	59			
1	,, ,,	63			
16	,, ,,	94			
1	,, ,,	110			
7	,, ,,	111b			
1	,, ,,	125			
3	,, ,,	126a			

OUR MAIL BAG

H. Vial (Kidderminster).—Thanks for photo of yourself surrounded by your Hornby Train system and Meccano models. They look fine!

J. Candler (Tulse Hill, S.W.).—You are probably right when you say that most boys have no idea how a gas-meter works. We will try to find room for an article on this subject, sometime. There are lots of Meccano girls, John, who derive great pleasure from building Meccano models, but, of course, girls as a rule do not take as much interest in things mechanical as boys. We are always very glad to see Meccano boys when they come to Liverpool, so hurry up and come along!

Manual Tubis (Philadelphia).—Yes, the Philadelphia-Camden bridge will be the largest suspension bridge in the world, but not for long. New York proposes to build one a great deal larger; it will cross the Hudson River and the centre span will be 3,240 feet long.

A. Scott (Cunnamulla, Aus.).—Your suggestion for a Meccano calendar is a good one, and we will see if it cannot be adopted. We will try to find a correspondent for you in India.

G. Tippings (Golborne).—We are sorry you have had such poor luck so far in forming a Meccano Club. Better leave it over now until next autumn, and then try again. Your stamp queries are being replied to by separate post.

S. F. Hazelton (Chelmsford).—We will consider your suggestion for a general "Queries" column. We fear there would go up a strong protest from the majority of our readers if we were to discontinue our Stamp Column even for a few issues. We can only add new features by enlarging the "*M.M.*" Let us give you a piece of information quite privately, just between ourselves:—We shall shortly add a new feature dealing with a new hobby for boys. This will be a hobby almost as attractive as Meccano itself. Now you may have three guesses!

F. Spear (Lauriston).—We have no room for serial stories just at present. In fact, we find that most of our readers prefer interesting and informative engineering and other articles, such as we are now printing.

E. P. Peterson (Chicago, Ill.).—Indeed you are not too old to derive pleasure from Meccano. We know of a number of men who get a great deal of enjoyment from Meccano model-building. "Anywhere from 5 to 70 years is the Meccano age," you know.

J. Alston (Camberwell).—We get lots of riddles sent to us by readers and these will find their way into our "Puzzle" column, but your's is hardly suitable, we fear. "John and James were brothers. John said to James, 'Your father is not my father and your mother is not my mother.' What is John?" After much thought we can only come to the sorrowful conclusion that he is what David said in his heart all men were! Perhaps some of our readers can provide an answer which shows John in a better light.

J. C. Rishworth (Tiptur, India).—We read your last letter with great interest. If at any time you are able to send us photos of the country and the work you describe so well, we will endeavour to publish them.

Rex Andrews (Wichita, Kansas).—We are very sorry to learn that a terrible Kansas storm tore down your aerial. Unless we are badly mistaken, no storm is strong enough to blow away your enthusiasm for Meccano.

J. E. Govan (Birkdale).—You need have no uneasiness about our publishing further serial stories for some time. We have no room for them. By all means send along the article that you have written for us. We wish more boys would try their hands at writing suitable articles for our columns for we like to encourage those who have any literary ability.

S. A. Saunders (Smethwick).—

"There was an old man of Nantucket
Who kept all his "dibs" in a bucket,
His daughter named Nan
Ran away with a man,
And as for the bucket—Nantucket."

Terrible, Sydney!

Buera Hamman (Colorado Springs, U.S.A.).—We regret that you are ill and hope you will soon be restored to perfect health. It is very nice to learn that Meccano has helped you to spend the long wearisome hours more pleasurably.

L. Fletcher (Glasgow).—We are pleased to know that you take such a great interest in railways, and that you know so much about them. We are rather surprised to learn from you that the average life of a locomotive is only thirty years. We suggest that perhaps it would live longer if it didn't smoke so much!

Brandes

THE NAME TO KNOW IN RADIO

Result of 15 *years' experience*

Jack chafes at an evening with his school text-books but he is always willing to further his education in a more pleasurable way—by Wireless. He gets the facts distinctly and accurately with Brandes "Matched Tone" Headphones—and is a fearsome authority on sporting records to the obvious discomfiture of his schoolfellows.

PRICE 25/-

BRITISH MANUFACTURE

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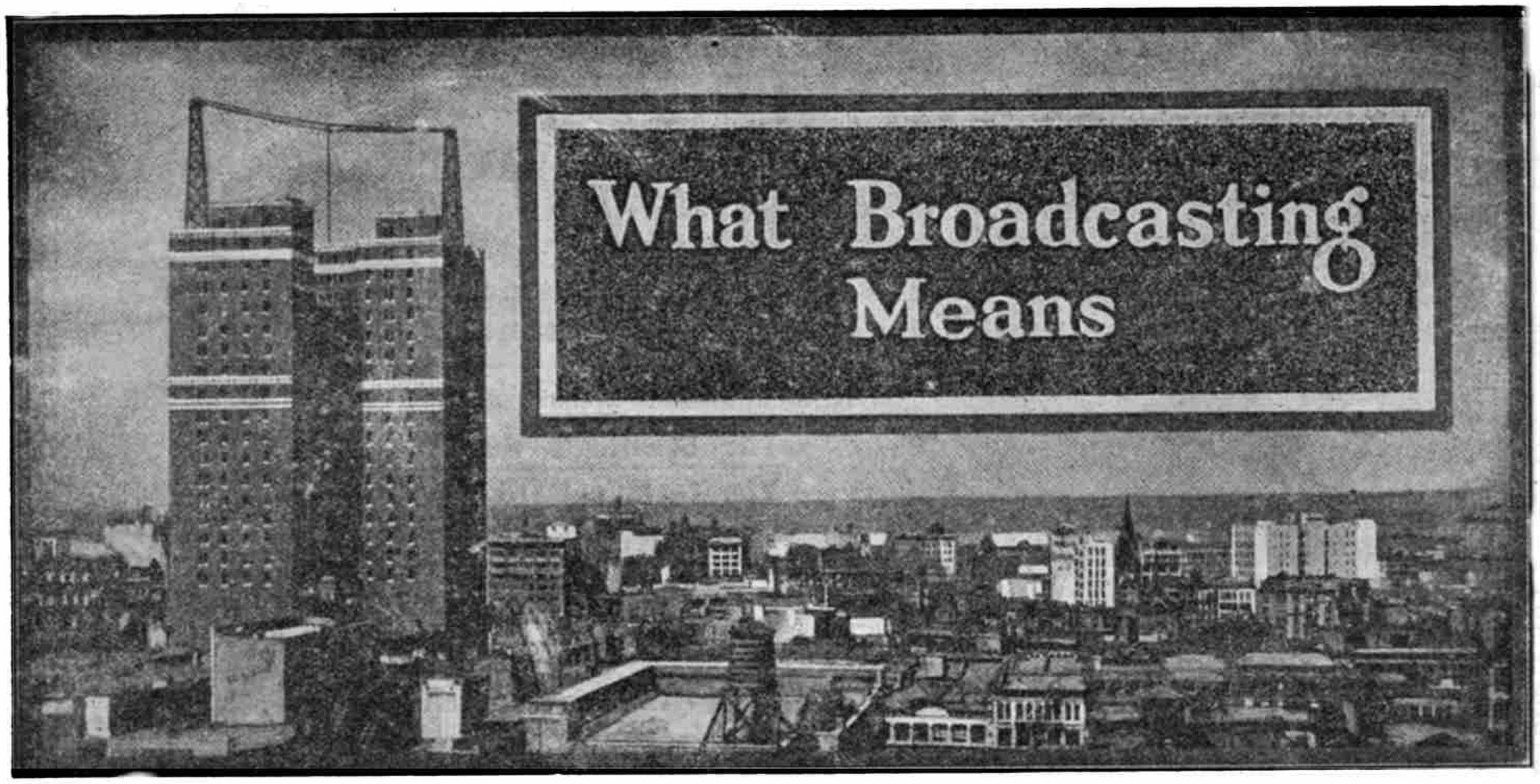
Matched Tone
TRADE MARK
Radio Headphones



II. COVERING BRITAIN WITH BROADCAST

THE wonderful possibilities of wireless telephony had been thoroughly demonstrated by the end of 1919, and had aroused widespread interest. Early in 1920 the Marconi Company carried out a number of important tests at Chelmsford, and these were remarkably successful. Madame Melba took part in one of them, and her singing was heard, not only in various parts of Europe, but as far away as Persia.

In July of the same year an even more striking success was achieved. The steamer Victorian, which conveyed a number of the delegates to the Imperial Press Congress in Canada, had a wireless set installed. During the whole voyage across the Atlantic, with the exception of a few hours, the vessel was in constant communication with either Chelmsford on one side or St. John's, Newfoundland, on the other. From time to time during the trip gramophone records were transmitted by the Victorian, and were heard by ships several hundred miles away. The excitement of the wireless operators of the various ships, who suddenly heard songs or instrumental solos when they were expecting nothing but Morse dots and dashes, is better imagined than described.

American Broadcasting Muddle

By this time a serious epidemic of "wireless fever" had broken out in the United States, and before the end of 1920 broadcasting was in full swing there. The country simply rushed headlong into a wireless boom, without any kind of Government control, with the result that transmitting stations sprang up by the score, all broadcasting on closely similar wavelengths. Very serious confusion followed, and when the demand arose for broadcasting in this country, the Postmaster-General refused to grant any concessions until a sound scheme, designed to prevent any repetition of the American muddle, had been agreed upon.

The Chelmsford transmissions in 1920 were followed by the famous Writtle concerts on Tuesday evenings, which began early in 1921 and continued up to the beginning of 1923. In May, 1922, the Marconi Company opened the London Station, 2LO, and gave a number of concerts. The success of these various transmissions had by this time convinced everybody that broadcasting had come to stay.

The British Broadcasting Company

After prolonged negotiations between the Postmaster-General and the principal electrical firms, a sound scheme of broadcasting was decided upon, and on November 14, 1922, the British Broadcasting Company came into existence, with Lord Gainford as chairman. The company undertook to provide eight broadcasting stations, to cover England, Scotland and Wales, and three of these stations, London, Manchester and Birmingham, were put into operation immediately. About a month later the Newcastle station was opened, and last year the remaining four stations commenced as follows:—Cardiff, February 13; Glasgow, March 6; Aberdeen, October 9; and Bournemouth, October 17.

Broadcasting Programmes

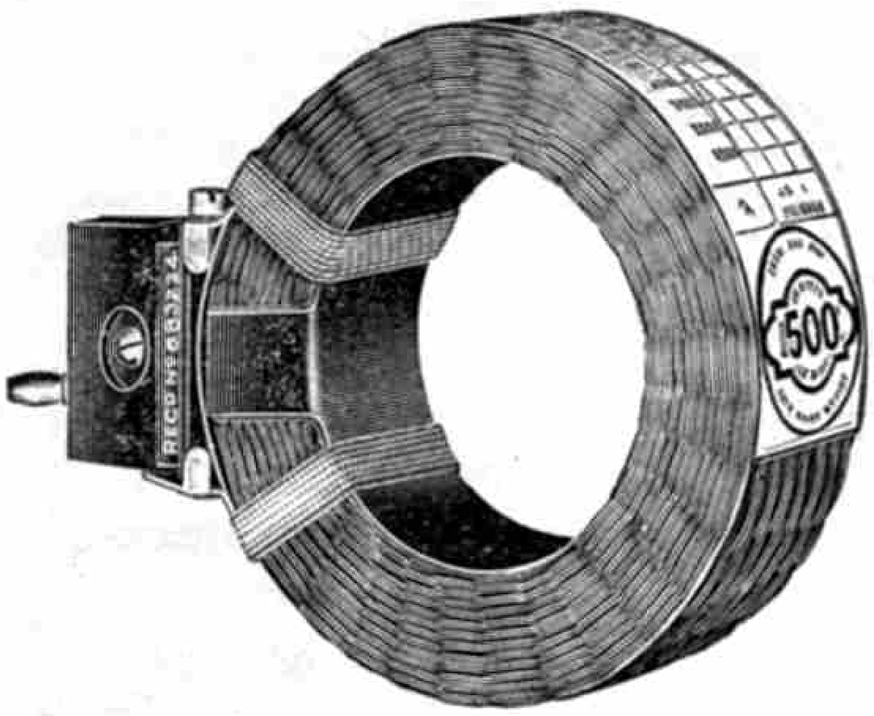
From the outset it was evident that, apart from engineering problems, the Broadcasting Company's greatest difficulty would be to cater for the widely differing tastes of its listeners. The task was tackled resolutely, however, and as the result of experiment and criticism the broadcasting programmes have improved steadily month by month. Music occupies the greater part of the programmes, and the musical policy is directed by Mr. Percy Pitt, of British National Opera Company fame. Every kind of music is included, from classical to jazz. Another important feature is that of "talks," which include the women's hour, stories for children, and short lectures on various topics of general interest. Then there are the news bulletins, in which important items are clearly stated in the fewest possible words. The weather forecasts, supplied by the Air Ministry, are another regular feature of every programme.

(*Continued on page* 127)

CALL LETTERS AND WAVE-LENGTHS

The following table gives the call letters and wave-lengths of all the British Broadcasting Stations, and the wave-lengths of the only relay stations open at the time of writing.

Station	Call Letters	W.L. in Metres
Aberdeen	2BD	495
Birmingham	5IT	475
Bournemouth	6BM	385
Cardiff	5WA	353
Glasgow	5SC	420
London	2LO	365
Manchester	2ZY	375
Newcastle	5NO	400
Sheffield	2FL	303
Plymouth	5PY	330



IGRANIC
PLUG TYPE HONEYCOMB COIL
(De Forest Pat. No. 141344).
Obtainable from all Dealers. Write for Lists Z.177.

It is not by accident

that

IGRANIC HONEYCOMB DUOLATERAL COILS

are in greater demand than any other Inductance Coils.

It follows from combining in them the results of

The Scientist's Research

The Technical Designer's Knowledge

The Expert Craftsman's Skill

The illustrations which have appeared in the various Radio Journals show that Captain Eckersley used

IGRANIC COILS in the Receiving Set for His Majesty the King.

MANCHESTER : 30, Cross Street.
BIRMINGHAM : 73/4, Exchange Buildings.
GLASGOW : 50, Wellington Street.

149, Queen Victoria St. LONDON.

IGRANIC

CARDIFF : Western Mail Chambers.
BRADFORD : 18, Woodview Ter., Manningham.
NEWCASTLE : 90, Pilgrim Street.

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RADIO SUPPLIES

Receives Signals and Broadcasting Entertainments loudly and clearly within a radius of 20 to 25 miles. The Volume and Purity of sound is equal to Crystal Sets sold at many times the price.
Complete with the "SONYTE" Crystal ... **5/6**
Plus B.B.C. Fee, 1/-.

The **"SONYTE"** Lightweight Double Head Receivers, 4,000 ohms, complete with Cords ... **17/6**

SINGLE HEAD Do., complete with Cords **8/-**

The **"CLARISTAL"** Aerial Set, comprising 100 feet Stranded Aerial Wire, 6 Insulators, Porcelain Leading-in Tube, Leading-in Wire, etc. ... **3/6**

The "CLARISTAL" Receiving Set.
(Complete as illustrated).
Including **"Sonyte"** Double Head Receivers and Aerial Set. *Including B.B.C. Fees* ... **27/-**
As above with Single Head Receiver ... **18/-**
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Fully illustrated Radio Catalogue showing a wide range of Complete Sets, Constructional Sets and Components of every description, post free on request.

The "Sonola" Low Frequency Transformer
Unsurpassed for silence, efficiency and reliability. Equally suitable with every type of valve.
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No Transformer gives better results!

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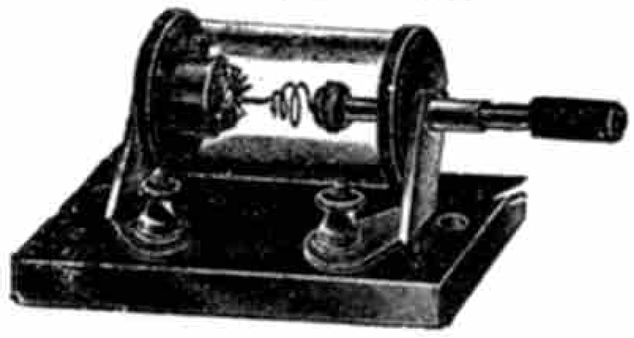

Open Type mounted on Ebonine Base.
No. 380 ... ... **1/3 each**
Enclosed Type fitted with Glass Dust Shield.
No. 400a As Illustrated ... **2/3 each**
De Luxe Model, high grade finish.
No. 400 ... ... **2/9 each**
De Luxe Model, Nickel finish.
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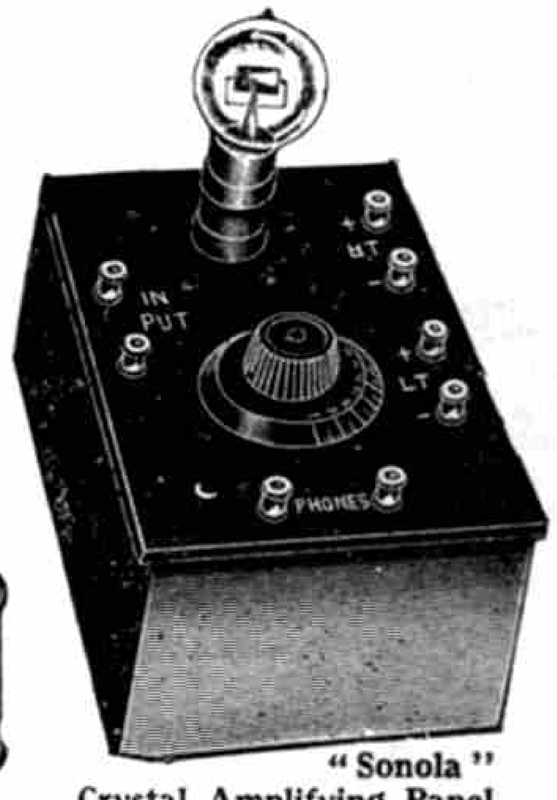


"Sonola" Crystal Amplifying Panel
Can be readily attached to any type of Crystal Set with wonderful improvements. The volume of sound is magnified enormously, and compares very favourably with the results obtained on the majority of Two Valve Sets. Complete in polished hardwood case fitted with substantial Ebonite Panel, **£2 16 6.**
Broadcasting Fee extra 5/-
Marconi Royalty ... ,, 12/6
Complete Set of Parts for constructing own Set, **£1 14 6.**
Marconi Royalty ... ... extra 12/6

THE UNIVERSAL ELECTRIC SUPPLY CO. LTD.,
4, BROWN STREET, MANCHESTER.
(Box No. G.P.O. 519). Est. 1892

What Broadcasting Means (cont. from p.125)

At each broadcasting station there is a station director who has the difficult task of planning out programmes and arranging for the necessary singers, players, etc. The difficulty of this work is enormously increased by the fact that the arrangements have to be made six weeks ahead, and are always liable to be upset by the occurrence of some special event.

The announcer, of whom we wrote in our previous article, has to act as a sort of stage manager, in addition to actually announcing the items and reading the news bulletins. He is responsible for carrying through the programme to a successful conclusion, and for dealing with the many little emergencies which arise from time to time. Then there are the engineers, of whom we hear little, but without whose skill and vigilance the station would quickly be in trouble. The transmitting set, with its glowing valves, has to be watched continually for slight defects, which may occur at any moment and must be rectified immediately. Even more attention is needed in manipulating the microphone amplifier, reducing too loud sounds, amplifying weak sounds, and generally controlling the volume of sound going to the power valves.

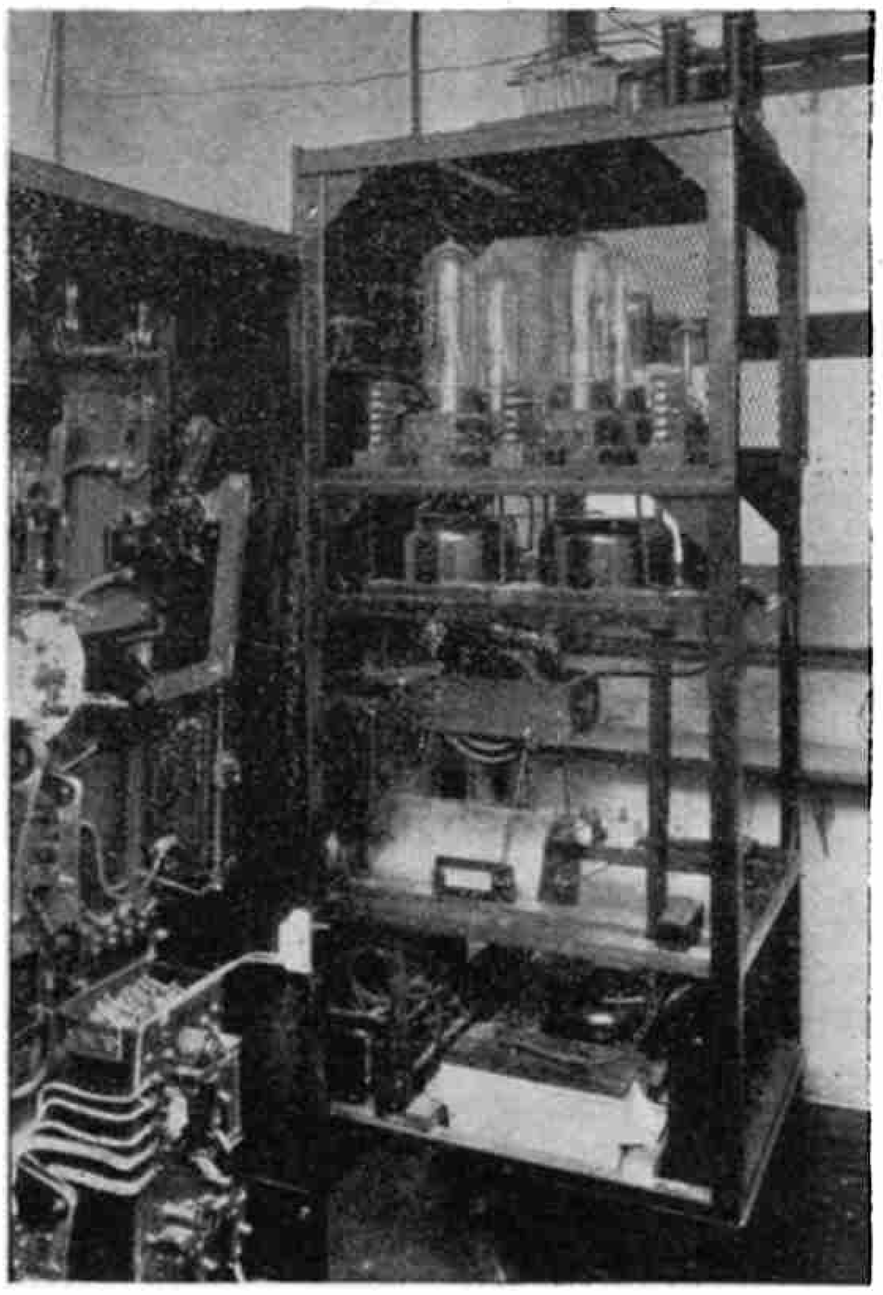
Simultaneous Broadcasting

In addition to the programmes arranged and transmitted by each broadcasting station, there is also an exchange of special items between the stations by means of simultaneous broadcasting. The London station does most of this, on account of its greater facilities for obtaining items of outstanding interest. Trunk telephone lines, specially tested for freedom from noise in transmission, connect the London station with each of the provincial stations.

If it is wished to transmit simultaneously to the whole country a London concert, the music is passed through the London station microphone and amplifier, and is then distributed to these trunk lines. Each line has a power amplifier of its own, to give a final strengthening of volume, and so the music reaches each station, to be broadcast in the ordinary way. On the other hand, a provincial station may have a particularly good item which it is desired that all stations should hear. In this case the item is strongly amplified at the provincial station, sent to the London station by trunk line, and distributed as we have just described.

Simultaneous broadcasting made possible the successful reception of American broadcast by users of crystal sets in many parts of Britain. It was received at the London station and simultaneously broadcast from there to all British stations.

It is of interest to know that land lines for simultaneous broadcasting from the London station to all other stations are available every day from 6 p.m. to 6 a.m. During these hours the lines are entirely under the control of the British Broadcasting Company, who are therefore able to eliminate interference. There are different lines for speech, music, and control.

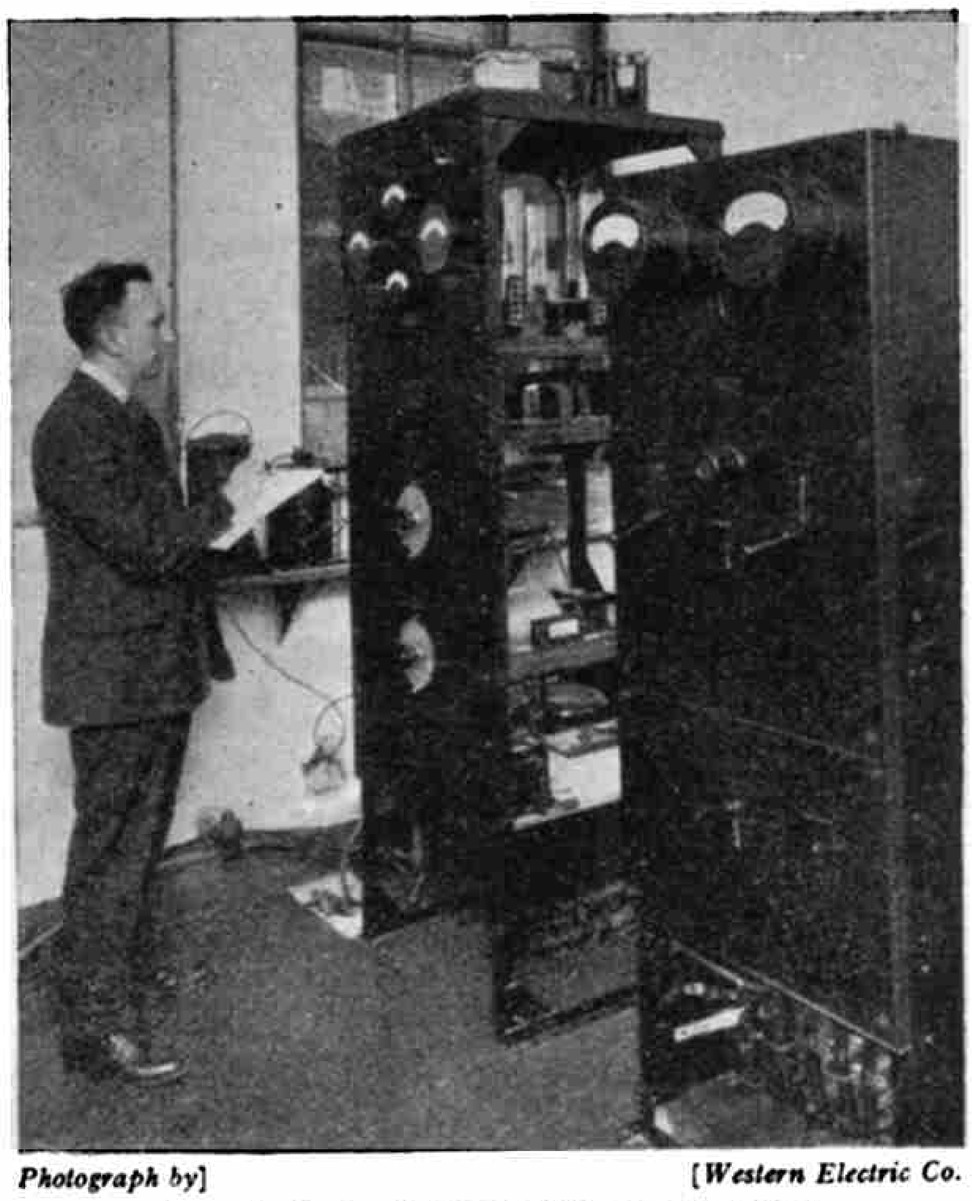


Photograph by [*Western Electric Co.*

Rear view of transmitting apparatus, showing the four 250 watt valves

Curious Fact in Long-Distance Broadcasting

A remarkably interesting state of things arises in connection with long-distance broadcasting, on account of the enormous difference between the speed of electric waves and that of sound waves. Wireless waves travel at the rate of about 186,000 miles per second, while the speed of sound waves is only about 1,100 feet per second. A wireless signal would cross the Atlantic in about one-sixtieth of a second, whereas in that time sound would travel less than twenty feet. Therefore, if a band performance were being broadcast to America, listeners in America would hear the music before people standing more than 20 ft. away from the band in the same room!



Photograph by [*Western Electric Co.*

Front view of transmitting apparatus

The engineer is watching the ammeter (at the upper part of panel), and is thus following the modulation of the voice of the speaker.

Relay Stations

At the present time the eight broadcasting stations in operation in Great Britain are intended to cover the whole of England, Scotland, and Wales, and they do so for the fortunate possessors of good valves sets. For instance, the approximate effective range of each station for a two-valve set is about 100 miles, and there are only a few thinly-populated areas in Great Britain more than 100 miles from any broadcasting station. The case of the owner of a crystal set is very different, however, for the range for a crystal set is only about 25 miles, which means that there are many densely-populated areas in which crystal sets are practically useless.

Experts state that it is not possible to get over this difficulty by increasing the number of broadcasting stations, as this would cause confusion. A remedy has been found, however, in relay stations. These stations are much smaller and less powerful than the big "eight." They receive the broadcast programmes from the main stations by land lines, and re-transmit them by wireless. In this way many thickly-populated areas, which are far from a main broadcasting station, may be brought within range for crystal sets.

Relay stations are already in operation at Sheffield and Plymouth, and others will follow at Edinburgh, Liverpool, Rawdon, and Hull.

Army of Nightly Listeners

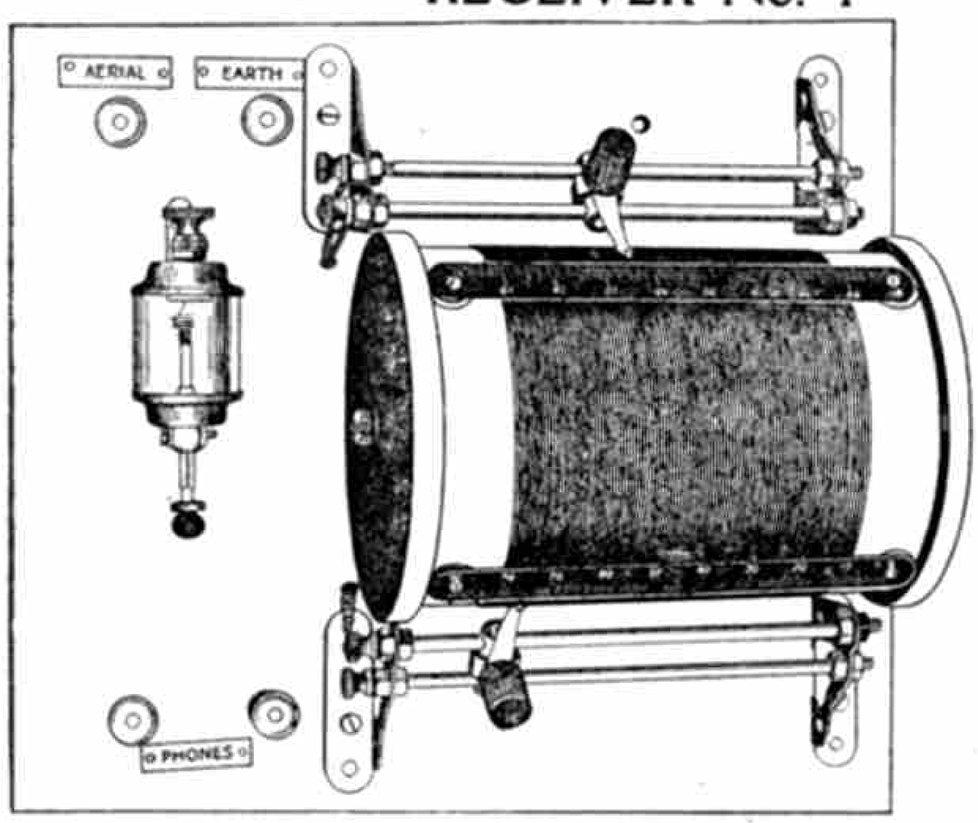
It is interesting to endeavour to estimate the number of people who listen to broadcast each night. Up to date more than 700,000 wireless licences have been issued. If we allow an average of three listeners to each licence, this makes a total of over 2,100,000 listeners in Great Britain.

The fact that the popularity of wireless is not decreasing is evident from recent figures issued by the Postmaster-General. These figures show that the number of broadcast receiving licences issued between October 1923, and February 1924, inclusive, in nine postal districts, was as follows:

London ...	200,000	Aberdeen ...	10,000
Cardiff ...	16,000	Bournemouth	9,000
Sheffield ...	8,000	Newcastle	30,000
Birmingham	30,000	Glasgow ...	44,000
Manchester	39,000		

Approximately 83,000 broadcast licences were in force in the whole of Scotland on February 29 last.

LISTEN WITH MECCANO RECEIVER No. 1



The Meccano No. 1 Receiver is a highly efficient and splendidly finished instrument. The crystal detector is exceptionally sensitive and is enclosed in a glass chamber. Two slides are provided, one on each side of the inductance, giving greater selectivity and clearness of reception. Wave length: zero to 1,000 metres.

Dimensions of Set: $9\frac{3}{4}'' \times 8\frac{1}{4}'' \times 5''$.

PRICE, post free (as illustrated), 15/9.

Meccano Ltd., Binns Road, Liverpool

The Meccano Double Headphones are British-made and of the highest quality procurable. They give loud, clear, undistorted reception, and will add greatly to the efficiency of any receiver. Comfortable to wear and easily adjusted. 4,000 ohms resistance. PRICE (post free), 15/6.

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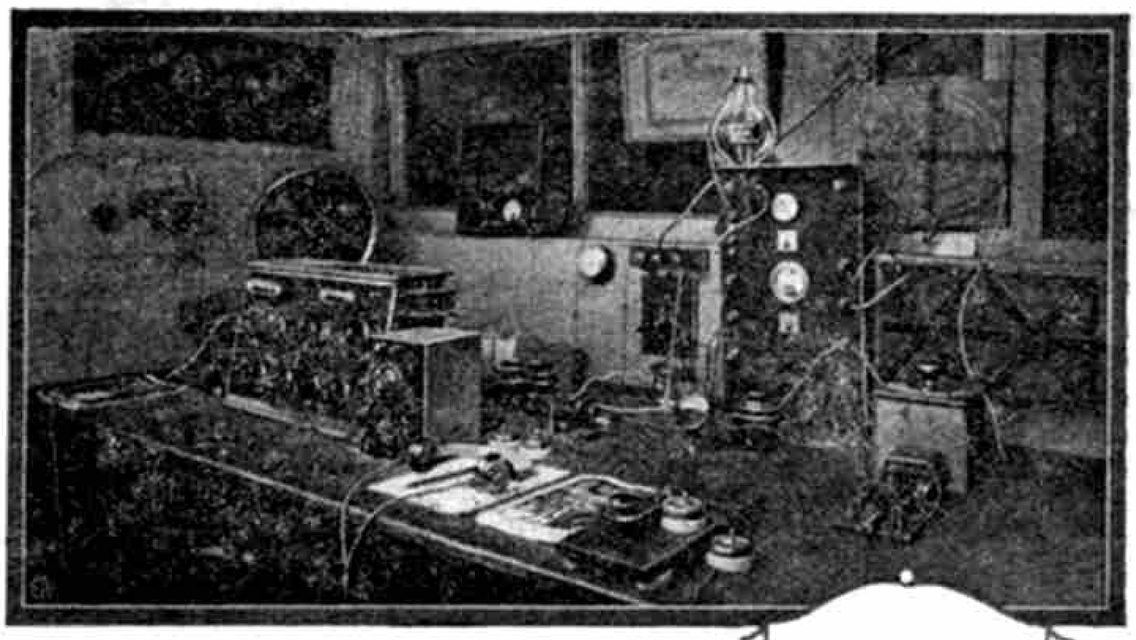
WIRELESS VALVES



2KF. Mr. Partridge, Mitcham. The Mullard receiving valves are on the left and the Mullard transmitting valves on the right.

First Across.

YOU know the keenness and the rivalry which goes to win the coveted phrase "First across." Every wire is subjected to most careful scrutiny, but the choice of valve is almost a religious ceremony, so essential is the right selection of the valve.

*The **First** amateur "First across" the Atlantic, working both ways, was*

MR. PARTRIDGE, MERTON LANE, MITCHAM,

*and the **First** schoolboy*

Mr. C. W. Goyder, Mill Hill School

They both used

MULLARD MASTER VALVES

Why not get the best out of your set? The Mullard range is comprehensive and any dealer can supply you with the right Mullard valve for your circuit or set.

Ask him to-day.

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(E.P.S. 140

BRIDGING THE ATLANTIC

Schoolboy Transmits to America

THE Radio Society of Great Britain recently organised a series of trans-Atlantic tests for amateur wireless enthusiasts, with a view to experimenting in transmission to and reception from America. About 60 British amateurs entered for these tests, including several well-known English amateur stations. One of these was the station of the great public school at Mill Hill, near London (2SZ). The operator of this station was Mr. C. W. Goyder, a pupil at the school who has been interested in radio for some time.

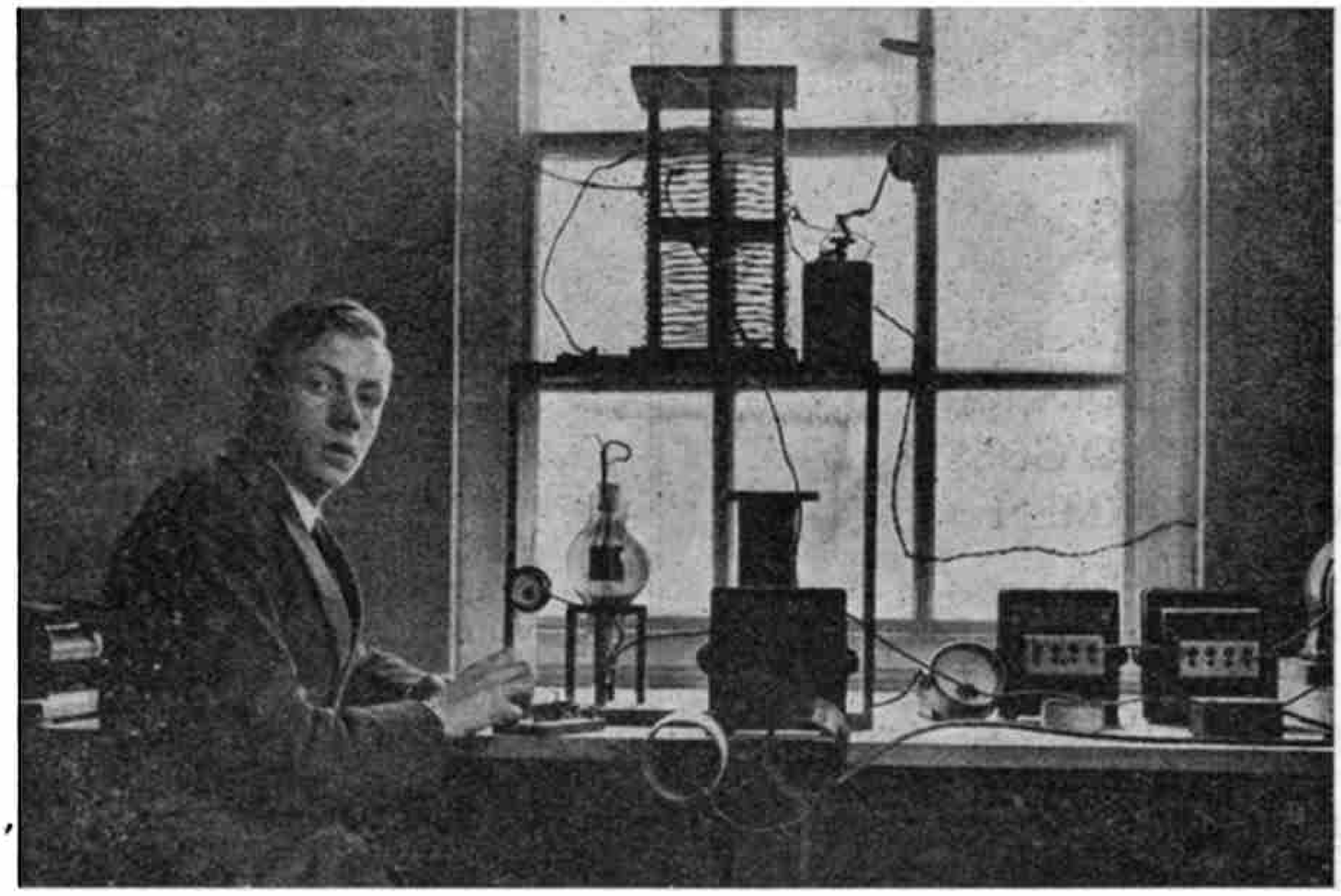
Choosing a Site

In order to take part in the tests it was necessary to use a higher-powered transmitting set than is allowed under the usual transmitting licence. The Mill Hill Station was fortunate in obtaining a 250-watt transmitting licence from the Postmaster-General and permission to use a wavelength of 100 metres, a wavelength that has been found to be the most suitable for long distance work.

The obstacles which confronted Mr. Goyder were considerable and would have deterred any less enthusiastic amateur. One great difficulty was the fact that the new science buildings, which were chosen as being the only suitable site for an aerial, were still in the process of erection. Walls and ceilings were unplastered, the floor was unlaid, and the window frames had to be stuffed with newspapers to keep out the draught. Even the staircase had not been built, and the room could only be reached by a ladder! It could scarcely be termed an ideal room in which to spend the twenty nights required for the tests. It had one possible advantage, however, that the operator was unlikely to be troubled by curious visitors during one of the critical tests!

Aerial Details

After several narrow escapes from disaster the set was at last installed in the half-built science room, and a cable laid for current to the chapel nearby. Readers of the "*M.M.*" will be interested to learn that our familiar advertisers, the Mullard Radio Valve Co., kindly loaned two Mullard Valves of the 0 250/C type for the tests, and it must be satisfactory to the manufacturers to know that their products enabled the operator to make wireless history. One of the Mullard valves is to be seen in the illustration, while above it is the cage-lead to the aerial and counterpoise. The 5-wire aerial, 55 ft. in length and 22 ft. above the roof, was fitted with 10 ft. spreaders. The lead-in, which was of the cage type, was fitted with rings of 3-ply wood, and was brought in through the roof. Eight wires were stretched between two cross wires below the aerial for the counterpoise, and were attached to the roof by hooks, with another lead-in, also of the cage type.



Mr. C. W. Goyder, the Wireless Amateur, and the apparatus with which he succeeded in transmitting to America

Two Aerials Used

A single wire aerial—the type most suitable for reception—was also erected, pointing in the direction of America. The "earth" consisted of a copper earthing mat ("borrowed" from the school O.T.C.), buried under the window to a depth of 3 ft.

The inductance used consisted of ¼" cable wound on the frame above the transformer, the clips fastened to it being adjustable for varying the wavelength. In the centre of our illustration is to be seen the transformer, which lights the transmitting valve. A reading of the amount of current passing is obtained from the ammeter shown to the left of the valve. The two panels on the right of the photograph are transformers for supplying current to the valve plate. The current used was rectified alternating current, at 2,500 volts potential.

First Night of the Test

While this set was being assembled the school term was still in progress. On December 18, however, Mill Hill "broke up" and Goyder was left in sole possession. The official tests were due to start on December 22, but on the night of the 21st Goyder decided to try his set. Working on a wave-length of 200 metres he was successful in picking-up several American stations, but no reply was received to messages sent out.

The first night of the test was unlucky, for at the very moment when officially due to transmit, the radiation of the set suddenly dropped to half normal. The reason for this mysterious occurrence was not discovered until two days later, when the trouble was traced to a piece of wet string hanging on the counterpoise and causing a leakage to earth! Troubles have an unpleasant habit of never coming singly, particularly in wireless, and on a subsequent night a valve was ruined through permitting an external wire to touch the valve, and spark through the glass. Also another leakage was caused by workmen leaving a piece of loose wire over the counterpoise!

First American Two-way Communication

At last the station was in working order, however, and on December 31 an American amateur living in New Jersey (2AGB) was plainly heard calling all stations. Goyder immediately called him up on the 100 metre wavelength and succeeded in getting his message across the Atlantic, for he received a reply from 2AGB shortly afterwards. Communication between the two stations was continued for some time, and Goyder took down three New Year messages for France. Arrangements were then made to carry on the next morning if possible, and before closing down, 2AGB sent *"You are the only European station heard here to-night."*

At 6 a.m. on January 8 Goyder established communication with an American amateur (1XW) at Hartford, Conn., and worked with him for two hours. Conditions were particularly favourable that night, and signals were so loud and clear that when Goyder called his friend 2AGB, the latter was able to hear Goyder's signals at a distance of even 4 ft. from his phones and 75 to 100 ft. from the loud speaker! The next night a Canadian (1BQ) at Halifax, Nova Scotia, was picked up on 110 metre wavelength and signals were exchanged.

Reports of the reception of Goyder's signals soon began to come in from U.S.A.

(Continued on page 131)

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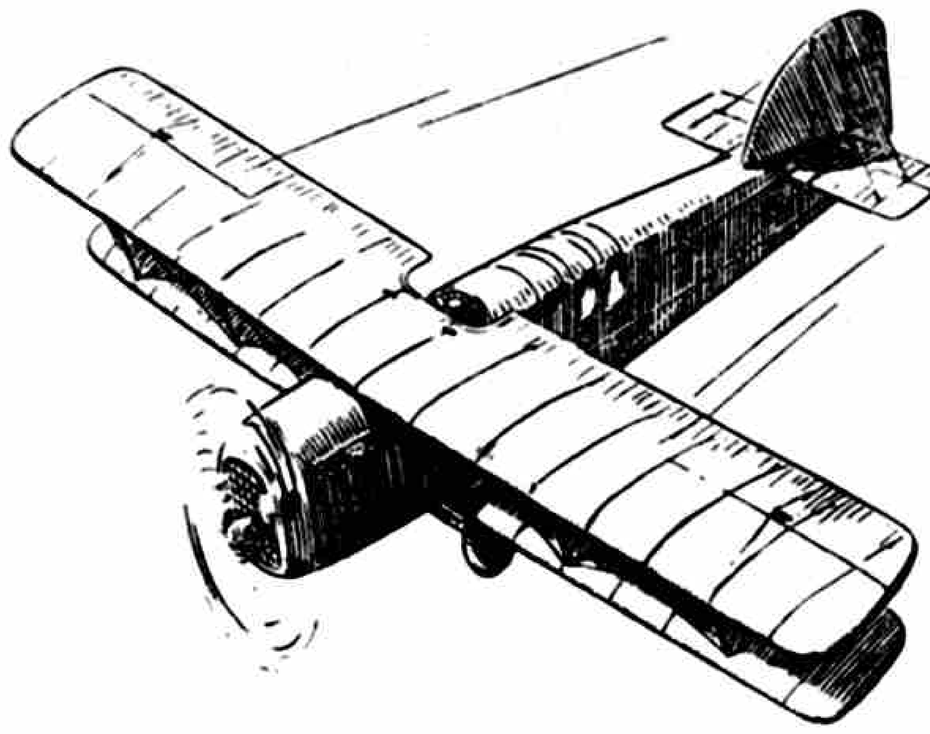

Where the little things count

Aeroplane construction must be attended with extreme care. From the wonderfully-designed and powerful engine—the wooden structure of selected, seasoned spruce—even down to the wire bracings, everything must be thoroughly tested. One little flaw or weakness may lead to disaster.

And so with that wonderful piece of mechanism, your body. It must be carefully tended, tuned up and prepared to fight the battle of life. It must be a healthy, vigorous body.

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To keep the teeth in perfect condition is a simple and pleasant matter by the twice daily use of Gibbs Dentifrice. It cleans and brightens the teeth by removing the greasy food deposits and polishing the millions of tiny waves and facets into which the enamel of a normal tooth is divided.

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FREE! Your little brother or sister will be keenly interested in the Gibbs Fairy Book "THE FORTRESS OF IVORY CASTLES"—a sequel to the famous "Ivory Castle Fairy Book"—an enthralling story comprising 36 beautifully illustrated pages. Sent post free, together with a useful size sample of Gibbs Dentifrice, on receipt of 3d. in stamps to cover cost of packing and postage.

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A radio station is shortly to be installed in Vancouver. The cost is expected to be in the neighbourhood of 2,000,000 dollars.

* * *

A taxi-cab company in Paris has applied for permission to equip its vehicles with receiving apparatus.

* * *

An enterprising Lincoln barber has installed a radio receiver in his saloon for the use of customers.

* * *

The control of a steam locomotive by radio was recently accomplished in America.

* * *

Messrs. Harland and Wolff Ltd., are building life-boats equipped with wireless installations in the forecastle. The first of these boats has just been delivered to one of the largest British Steamship Companies.

* * *

A message from the Birmingham broadcasting station has been picked up at Ontario, Canada. Birmingham was distinctly heard calling "This is the broadcasting station at Birmingham, England. We are testing for the benefit of continental and American cities, which we hope to pick up our station."

THE "Revo" REGD

LITTLE GEM CRYSTAL SET

Perfect reception—it's splendid.

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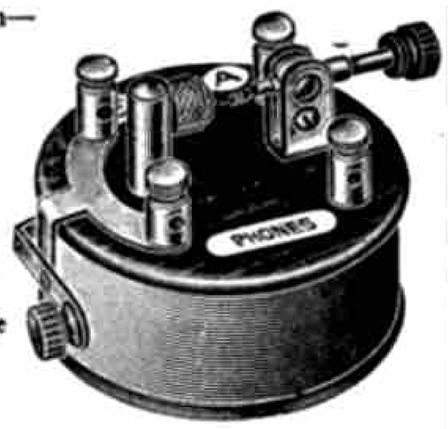
plus 1/- tax nett.

Postage extra.

Approved by the Postmaster General.



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Obtainable from any dealer or the manufacturers:

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TIPTON, STAFFS.

A scheme is under consideration whereby it is proposed to grant a licence to an Indian Company to broadcast. The decision on this matter is anxiously awaited by Radio enthusiasts in India, who have long felt the need for some such organisation.

* * *

More than a square mile of land has recently been purchased by the Post Office authorities at Hillmorton, near Rugby. This land is to be used for the erection of the largest wireless station in the world, the construction of which will take several years to complete.

* * *

Several railway coaches in this country have had wireless apparatus installed. This has proved an exceedingly popular innovation, and will help considerably to while away the tedium of long journeys.

Bridging the Atlantic—*(cont. from p. 129)*

and Canada, where the signals had been heard strongly as far inland as Denver* (Colorado), Chicago, and Atlanta (Georgia). Other interesting reports came from various parts of the world, including Lisbon and Algeria, and it was soon evident that Goyder's transmissions had been heard every night he had sent during the tests—i.e., nineteen times in all.

Regular Transatlantic Transmissions

Owing to the activities of the workmen on the new building, Goyder was not able to again connect up his set until February 9. Getting up at 5 o'clock next morning, he almost immediately got into touch with 2BN (Montreal), 3OT (Pittsburgh), 1XAR (Massachusetts), 1BQ (Nova Scotia), and finally his old friend BD1 (Maine University). An exchange of messages was carried on with this station for over an

(Continued in next column)

* Denver is a distance of about 5,000 miles from Mill Hill!

ELEVEN YEARS AGO!

THE WIRELESS WORLD AND RADIO REVIEW

was first published, and since then it has continued to be the Premier Wireless Journal.

Read what the **Editor of the "*M.M.*"** says about it on page 134, and then send for a free specimen copy. **Every Wednesday, 4d.**

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Kevin Dinneen (Limerick).—We are sure that you will derive as much fun from the Meccano Crystal Set as from the other Meccano products that you already possess. Write us if at any time you are in difficulties.

W. Melville-Arnott (Scotland).—The fact that you have received telephony with a Meccano Crystal Receiver at a distance of 50 miles from the Glasgow Broadcasting Station is certainly an accomplishment. We shall be interested to hear of your further experiences in this connection.

Messrs. Bradley (London) Ltd.—The manufacture of a Meccano Valve Receiving Set will not be proceeded with at the moment.

W. T. Samuels (Birmingham).—We are pleased to know that you are acquiring useful knowledge in connection with Radio. You will find that the Meccano Receivers are of great assistance to you.

William Blackie (Melbourne).—I would like you to let me have some first-hand information about the prevailing conditions governing Radio in Australia. There seem to be considerable restrictions.

T. Browne (Doncaster).—You are too far distant from the nearest broadcasting station (Manchester) to receive telephony with a Crystal Receiver.

Wm. Duckworth (Blackburn).—Instruction Leaflets for the Meccano No. 2 Crystal Receiver are still available, price 4d., post free.

William Epy (Saskatchewan).—Our Depôt at 11, Colborne Street, Toronto, will always be very pleased to answer any enquiry you may direct to them.

E. J. Neame (London, W.).—A special constructor's licence is issued for those who construct their own Radio Receiving Sets from Meccano or other parts. I trust you will spend many happy hours with your apparatus when it is completed.

V. Govett (London, W.2).—The Meccano Receiving Sets are No. 1 Radio Receiver (Non-Constructional), No. 2 Radio Receiver (Constructional). Presumably it is the latter to which you refer, and instructions for building this have already been forwarded to you.

J. Fogarty (South Dunedin).—The Meccano Depôt, 379, Kent Street, Sydney, will always be pleased to give you any information you may require in regard to the Meccano Receiving Sets.

Jack MacDonald (Dumfries).—I much regret that it is impossible to supply you with an earth wire separately, but you could obtain the necessary wire for this purpose from any electrician. The Meccano Aerial is only listed in its complete state.

hour, and Goyder gave him messages for several other amateurs whose signals he had received. This work was done with one Mullard O250c. Valve.

Wonderful Progress

We wonder how many of our readers can appreciate how pleased Mr. Goyder felt when he established communication with America, thus linking up the Old and New Worlds with invisible bonds. It was a very great achievement, and we gladly take this opportunity, on behalf of Meccano boys all over the world, of congratulating him on his achievement. It is indeed a wonderful and rapid advance from the time when Marconi first endeavoured to send messages over a few yards distance. At the present day a schoolboy is able to exchange messages with friends several thousands of miles across the Atlantic!

We are indebted to Mr. C. W. Goyder (who, by the way, is an old reader of the "*M.M.*"), for the photograph reproduced on page 129. He tells us that in the near future he intends to take up telephony in addition to telegraphy, although this will necessitate several additions and alterations to the apparatus. In the meantime, radio enthusiasts who are able to read Morse should listen for the call sign 2SZ between broadcasting hours and send their reports of reception to Mr. Goyder at Mill Hill.

ELECTRICITY

A series of Splendid Articles specially written for Meccano Boys

III. REAL AND ARTIFICIAL LIGHTNING

IN our previous articles we have shown how charges of electricity may be produced on rods of glass or sealing-wax by rubbing them with silk or flannel. If we try to produce a charge on a metal rod in the same way, however, we get no result at all. The reason for this is that glass and sealing-wax do not allow electricity to pass along them. The part of the rod we rub becomes charged, and the charge remains there because it cannot spread to the rest of the rod.

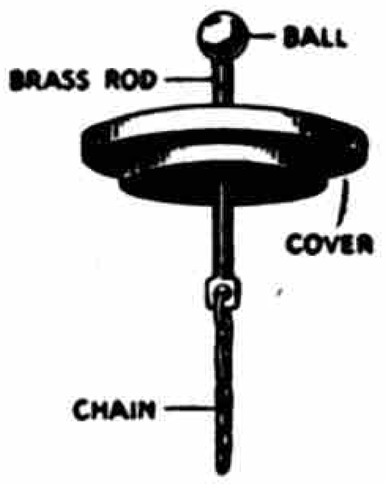

Fig. 12. Lid of a Leyden Jar

Conductors and Non-Conductors

On the other hand, metals allow electricity to pass very easily. Therefore when we rub a metal rod, electricity is produced but immediately spreads over the whole rod and escapes through the hand. Substances which allow electricity to pass easily are called "conductors," and those that strongly resist its passage are called "non-conductors." Metals, acids and the human body are three conductors; cotton, linen and paper are partial conductors; and air, resin, silk, glass, sealing-wax and gutta-percha are some of the non-conductors. It may be mentioned in passing that none of these substances is perfect in either respect, for all non-conductors have a certain amount of conducting power, while all conductors resist the passage of electricity to some extent.

Making use now of our knowledge of conductors and non-conductors, let us fasten a handle of glass or sealing-wax to a metal rod. If we take hold of this handle and rub the rod again, we find that it becomes charged just as our glass rod did. The electricity spreads over the metal rod as before, but it cannot reach our hand because of the non-conducting handle. In this experiment the metal rod is similar to an island, for it is a conductor completely surrounded by non-conductors (air and glass or air and sealing-wax as the case may be). A conductor guarded in this way is said to be "insulated," from the Latin word *insula*, meaning "an island." Similarly, non-conductors are called "insulators."

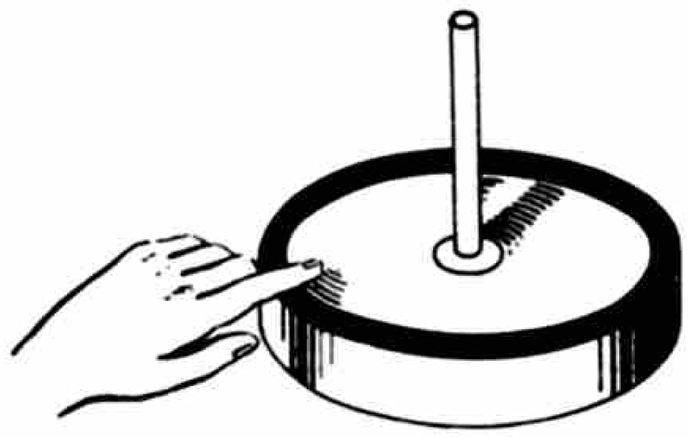

Fig. 11. The Electrophorus

An Interesting Device

The quantity of electricity produced by rubbing glass or sealing-wax rods is very small. Considerably stronger charges may be produced by means of an "electrophorus," an easily-made appliance, devised in 1775 by Alessandro Volta, an Italian professor of physics. Obtain the metal lid of a round tin—the larger the better—and fill it with melted sealing-wax. Out of sheet tin, zinc, or copper, cut a disc of slightly smaller diameter than the tin lid. If no sheet metal is at hand, the disc may be cut out of thin wood and covered with tinfoil. An insulating handle of sealing-wax or glass must now be fixed to the centre of the disc, and the electrophorus is complete.

To use the apparatus, the cake of sealing-wax in the tin lid is charged with negative electricity by rubbing it with a piece of warm flannel. The metal disc is then placed upon the sealing-wax, touched for an instant with the finger (Fig. 11) and lifted away by means of its handle. The disc now has a charge of positive electricity, which is so strong that if the knuckles of the other hand are brought near to its edge, a spark passes between disc and knuckles. The disc may be charged many times in this way for the original charge on the sealing-wax is not used up in the process. Leakage gradually takes place, however, and after a time the sealing-wax has to be re-charged by rubbing.

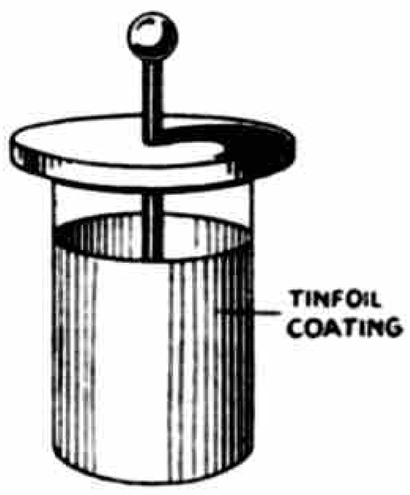

Fig. 13. The Complete Leyden Jar

In the electrophorus the cake of sealing-wax is charged by rubbing, but the metal disc is charged by "influence," or "induction." To put the matter in the simplest way, the negative charge on the sealing-wax so influences the disc as to attract a positive charge to its under side, and repel a negative charge to its upper side. When the disc is touched, the negative charge on its upper side escapes through the hand and body to earth, but the positive charge on the under side is so strongly held by the attraction of the negative charge on the sealing wax that it

Benjamin Franklin (1706—1790)

has to remain. When the disc is lifted, the positive charge is free to spread itself over both sides, but the insulating handle prevents it from escaping.

The Jumping Frogs

Many very interesting experiments may be performed with the electrophorus, but we have only space to mention one, which always causes great amusement. Cut out of tissue paper a number of small frogs (Fig. 14), moisten them slightly, and place them on the disc of the electrophorus. Touch the disc with the finger and lift it by the insulating handle, when the frogs will immediately jump off the disc on to the table (Fig. 15). (The experiment will not succeed if the frogs are too wet).

The Wimshurst Machine

An electric machine must be employed when very large quantities of static electricity are required. The first electrical machines were simply mechanical arrangements for rubbing glass cylinders against specially prepared cushions and were therefore called "friction machines." These early machines were very unreliable, especially in wet weather, and they are now superseded by machines which depend upon influence. This is the principle we have just mentioned in connection with the electrophorus, and in fact an influence machine is really a mechanically operated electrophorus. In the machine now in most general use, the Wimshurst, shown in Fig. 16, the glass or ebonite plates are made to rotate rapidly by turning the handle. The discharging rods then become very highly charged, and if they are close enough together crackling sparks will pass between them.

The Wimshurst machine gives us an abundant supply of electricity, and now arises the question of storing up some of this electricity.

The Leyden Jar

In 1745, a certain Bishop of Pomerania succeeded in collecting electricity from his primitive electric machine, in a bottle partly filled with water, and at the same time received a shock that startled him! This experiment was repeated soon afterwards by Professor Muschenbrock, of Leyden, with similar results, and the scared professor said he would not take a second shock for the Kingdom of France! By these experiments it was shown that electricity could be collected and stored up, and the bottle came to be known as the "Leyden Jar."

As now used, the Leyden jar does not contain water, but is coated with tinfoil inside and outside, up to about two-thirds of its height (Fig. 13). It has a wooden lid, through which passes a brass rod with a brass knob at its upper end, and terminating below in a piece of brass chain long enough to touch the foil lining (Fig. 12).

The jar is charged by holding it in one hand with its knob presented to the discharging ball of a Wimshurst machine. It may then be placed on the table, and if dry and clean will retain its charge for a considerable time. If the inner and outer coatings of the jar are connected by a piece of metal, the electricity stored up will be discharged in the form of a spark.

Leyden jars are often fitted to a Wimshurst machine, in such a way that they may be connected or disconnected as desired. When they are connected, they act as a considerable electricity discharge takes place, so that the sparks occur at intervals, but are thicker and more violent. In Fig. 16 the Leyden jars are shown at AA.

Fig. 14 Paper Frog

Franklin and the Lightning

The similarity between lightning and the detonating sparks from an electric machine is very noticeable, and indeed the sparks are artificial lightning in miniature. Many early observers had suspected the connection between such sparks and lightning, but it was left to Benjamin Franklin to settle the matter. Franklin, who was born at Boston, U.S.A. in 1706, became convinced that electricity and lightning were the same, and he resolved to test his theory. For this purpose he used a kite with a pointed wire at its top, and a key, insulated by a piece of silk ribbon, tied to the lower end of the flying string. He flew his kite one day in June 1752, during a severe thunderstorm, and found, to his intense delight, that when he brought his knuckle near the key a little spark passed, just such a spark as he had obtained so often in experiments with his electrical machine. To make matters quite certain, he charged a Leyden jar from the key, and performed a number of experiments with it that proved beyond doubt that electricity and lightning were one and the same.

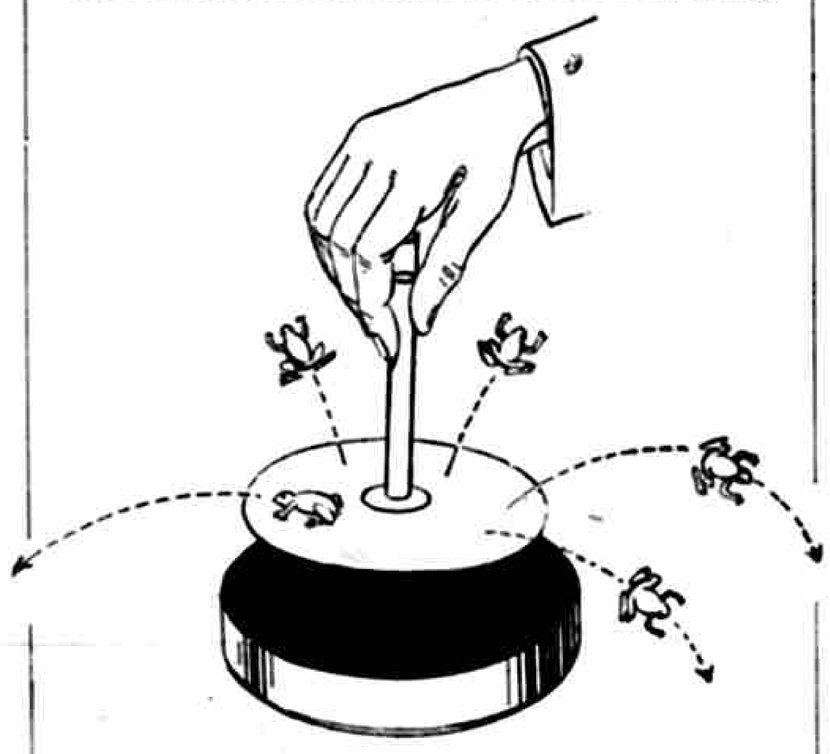

Fig. 15. The Jumping Frogs

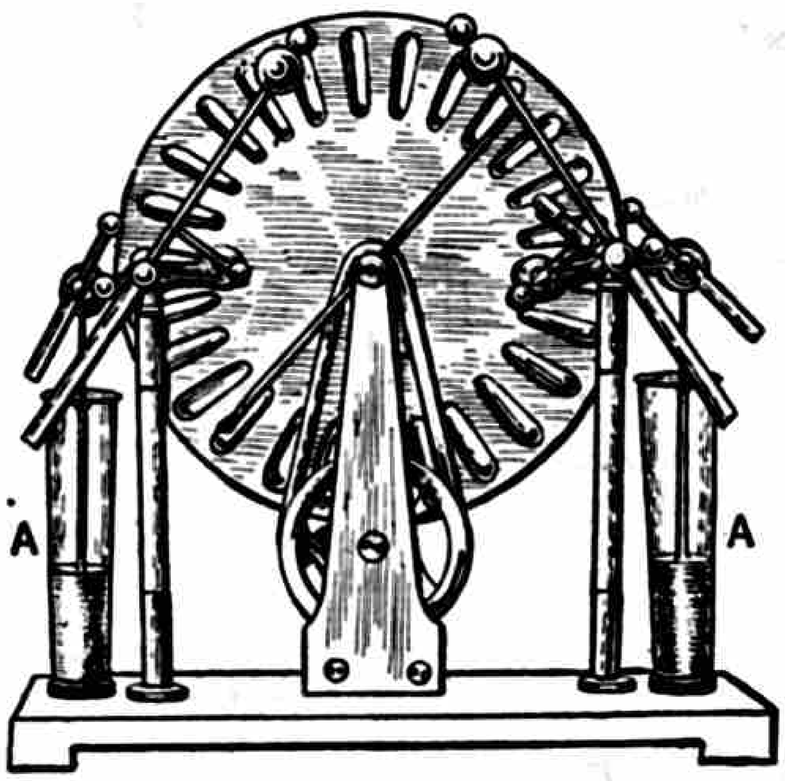

Fig. 16. Wimshurst Machine*

*Reproduced (by permission of Messrs. T. C. & E. C. Jack Ltd.) from *The Romance and Reality o Radio.*

Lightning is a tremendous electric spark passing between two clouds, or between a cloud and the earth. Clouds are generally charged with electricity to some extent, and when opposite charges become sufficiently strong the electricity leaps across the intervening air-space. The flash may be from one to ten miles in length. The thunder which accompanies the lightning is probably caused by the heating and sudden expansion of the air in the track of the discharge, producing a partial vacuum into which the surrounding air rushes with great violence.

Forms of Lightning

Lightning flashes take various forms, of which forked or zig-zag lightning, and sheet lightning are the most common. The zig-zag form is caused by the discharge taking the path of least resistance through the air, and sheet lightning is probably the reflection of a flash occurring at a distance. The so-called "summer lightning," seen on the horizon at night, is the reflection of a storm too far away for the thunder to be heard. There is also another form of lightning, the rare globular or ball-lightning, in which the discharge appears as a ball of light that moves slowly along and then bursts with a sudden explosion. Yet another uncommon form is multiple lightning, which consists of a number of parallel discharges appearing like a ribbon.

The Safest Place in a Storm

Every time a severe thunderstorm occurs we hear arguments as to which is the safest place. It is impossible to say that any place is absolutely secure against lightning, but generally speaking it is safer to be indoors than out in the open. If one is caught in a storm while out in open fields, the safest plan is to lie down, in spite of the rain. Umbrellas should never be used in a storm, as they are decidedly dangerous. Isolated trees, especially oaks, are very liable to be struck, and it is foolish to shelter under them. A fairly thick wood, on the contrary, forms a comparatively safe refuge. Animals are much more liable to be struck than human beings, and a shed containing cows or horses should be avoided.

Death by lightning is instantaneous, and for this reason quite painless. Our nerves cannot transmit sensations to the brain at a greater speed than about a hundred feet a second, and therefore lightning destroys life before any pain can be felt. Sometimes markings resembling branches are found on the bodies of persons killed by lightning, and often these are taken to be reproductions of trees. This is not the case, however, and the markings are merely a peculiar effect of the current on the body.

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Wireless World and Radio Review

(*Wireless Press, London. Price* 4d. *Weekly*).

An interesting review of the present position of the development of Television and survey of the great difficulties yet to be overcome is one of the most striking features of No. 243 of this well-known publication. Other noteworthy articles describe the construction of a Four-Valve Experimental Receiver and a Self-contained Portable Single-valve Set. The diagrams in both these articles are excellently done. In answers to readers' problems and other regular features this paper fully maintains its interesting and valuable character.

The Model Engineer

(*Percival Marshall. Price* 5d. *Weekly*).

As its name implies, the "Model Engineer" makes a special appeal to all who are interested in the construction and use of models. Published by Percival Marshall & Co., whose technical books are well known to readers of the "*M.M.*," it invariably contains a number of features which are of real interest to model builders. In a recent issue there are articles on a model fusilage glider, an adjustable tool-post and a four-valve receiver, replies to wireless enquiries, practical letters from readers, and many other interesting items.

London & North Eastern 4-6-2

(*Pub. by the Locomotive Publishing Co. Ltd. Price* 1/6 *net*).

Exceedingly well printed on art paper and measuring 2 ft. 4in. by 1 ft. 5 in., this chart of an express loco should be in the possession of every boy interested in railways or locos. It represents a 4-6-2 three-cylinder express locomotive of the "Pacific" type owned by the London & North Eastern Railway, with the outer casing of the engine removed to show the internal workings. A numbered list makes easy the identification of the different parts, and the chart forms an ideal decoration for bedroom or club room.

Underground Railways—(*cont. from page* 119)

of the power house. The snowball fell on one of the generators, melted, and caused a short circuit. There was a blinding flash, and the fuses were blown. Immediately the whole of the Tube trains came to a standstill, all lights went out, the moving staircases ceased to work, and the lifts remained stuck between station and roadway. It was half-an-hour before the current was restored, and the Tube resumed its normal conditions.

It is astonishing to think that such a vast organisation could be held up for half-an-hour by a handful of snow.

Some Interesting Figures

The railways comprising the Underground Group are the London Electric Railway (Piccadilly Tube, Bakerloo Tube, Hampstead Tube), the Central London Railway, the City and South London Railway, and the Metropolitan District Railway. The vast and ceaseless activity of these railways is shown by the fact that the total number of passengers they carry averages 350 millions a year. Every car on the railways carries an average of 250,000 passengers a year, and the average number of passengers using each lift is 1,750,000 a year.

When one considers these figures, it is easy to realise the vital importance of the underground railways to London, and more particularly so during an emergency, such as the recent strike, when no 'buses or trams are available.

We are indebted to the management of the London Underground Railways for permission to reproduce the photographs accompanying this article and the instalment that was printed last month.—EDITOR.

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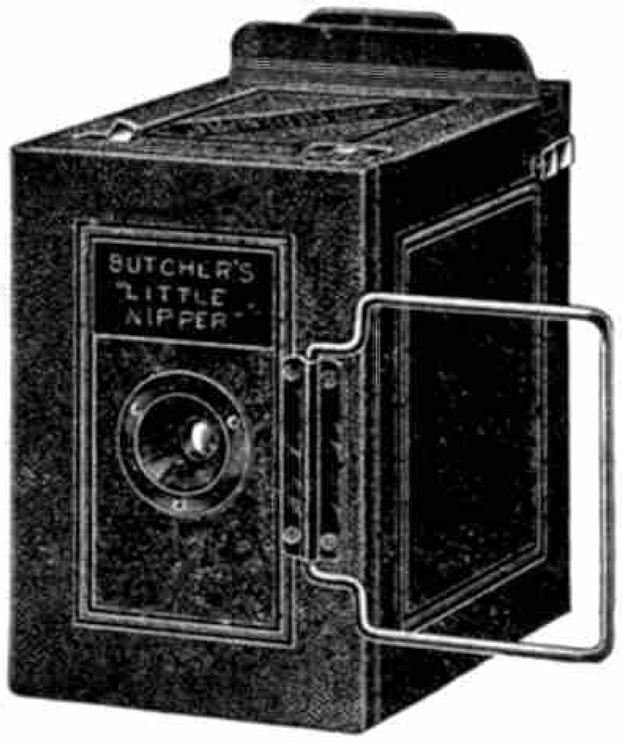

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BRIGHT IDEAS

In these columns we deal with ideas for new parts, new models, and new methods of making Meccano model-building attractive. We also deal with Hornby Train suggestions, and are always pleased to hear from any Meccano boy who has an idea which he considers will be useful to the system or to other boys.

J. H. Wilson (Dowlais, Glam.).—A spring coupling would be unsatisfactory, because the moment the slightest strain was applied the coils would at once give. At the best only a very jerky movement would be obtained. We introduced a complete universal oint last year.

P. Roberts (Prestatyn).—We think existing Meccano parts could be adapted to the two shapes you suggest. The feature of the Meccano system is its adaptability.

G. Thompson (Bristol).—We consider the present sprocket chain is quite strong enough for all normal purposes. If it were to be made of thicker material to give extra strength, as you suggest, it would not engage correctly with the teeth of the sprocket wheels.

J. Miller (Johannesburg).—The clockwork movement in the Hornby engine is not suitable for driving Meccano models.

Eric Warner (Swakopinund, B.S.W.A.).—In actual practice your suggested three-corner strip would serve only as a corner bracing piece. Several elements already in the Meccano system already fulfil this function. (2) At the moment we cannot see any useful purpose in the small diameter semicircular strip or in the double angle-strip with elongated holes. Perhaps you could suggest a use for this piece.

J. Candler (Tulse Hill, S.W.).—We appreciate the need of some means of attachment between a strip and a rod. We are going into the matter.

R. Maddock (Walsall).—Perhaps some day we may make longer strips to correspond with the long girders.

R. Leech (Rhyl).—A number of new Hornby train accessories is being added to the series this year. Amongst these are included a Snow Plough, Signal Cabin, Junction Signals and Tunnel.

O. Tomlinson (Glasgow).—The No. 00 Outfit was introduced last year. It is specially adapted to the use of very young boys, and is a very popular commencing Outfit.

H. E. Davies (Fortier, Manitoba).—We are afraid that boat hulls in conjunction with Meccano are impracticable. (2) A three inch gear wheel is obtained by fastening four rack segments to a face plate. (3) Helical gears are receiving our close consideration.

H. Chesters (Crewe).—(1) We shall probably have something to announce shortly in regard to a sliding movement. (2) Leaf springs may be constructed from our standard strip, and this type of spring is illustrated in the Chassis Leaflet.

R. Jones (Bristol).—We do not propose manufacturing steam models just yet. The matter of electric trains is under close consideration.

D. Bryce (Manchester).—Although a double crank shaft has not yet shewn itself to be of any great use up to the present, we are keeping the idea in mind.

C. Alligan (Douglas, I.O.M.).—We are continually adding to our list of train accessories. The coal wagon you mention is already on the market.

Mayhew (Brighton).—Although the use of curved braced girders would be confined more or less to bridges, we shall consider their introduction.

I. Kirton (Towyn).—The matter of a big end connection has already been dealt with in these columns. We think your suggestion would be too costly to manufacture.

H. Pettifor (Blackheath, S.E.).—Up to the present we have not received a demand from our many Meccano friends for the introduction of signal arms. Should such a demand ever materialise we shall certainly give it consideration.

J. Sherlock (Crewe).—Your suggested eccentric would be somewhat costly to produce. Would not our triple-throw eccentric serve the purpose?

Milton (Grantham).—Bent strips are included with each Outfit and make possible the construction of the models within the scope of the Outfits. Elaboration of models must, of course, be catered for by the addition of separate parts.

W. B. Allan (Lancaster).—The uses of a $12\frac{1}{2}" \times \frac{1}{2}"$ double angle strip are not yet very apparent and unless it should serve a fairly general purpose we could not introduce it. We are continually adding to the accessories for Hornby trains, and no doubt a mail bag apparatus will be added in due course.

L. Tuff (York).—(1) Cams have several times been suggested, but we do not see their uses in the Meccano system. (2) The curved strips lend themselves to the making of a complete circle. First of all outline your circle, leaving the bolts loose. When the circle is complete, tighten the bolts. There is a certain amount of play in the bolt holes which will account for the terminals of your circle not being in a true line.

V. Thompson (Woodhall Spa).—We find that cord and sprocket chains fill all the necessary requirements in power transmission. There would be no object in furnishing a variety of means all filling the same purpose.

F. Hibbert (Ashton-u-Lyne).—Although a flange in the clockwork motor commends itself, we are afraid its near proximity to the driving spindle would interfere with its satisfactory working.

W. J. Nuttbrown (Liverpool).—What special advantages has the form of standard you suggest?

Leon Nash (Uxbridge).—A 2" pulley wheel gives an excellent representation of an auto steering wheel.

"The Editor of the '*M.M.*' as I imagine him."

The Editor of the "*M.M.*," according to Master R. Waterston (Newcastle-on-Tyne), and, below, Master N. Shacklock, of Manchester.

Both these drawings won prizes in our recent Drawing Competition.

Painting Contest

A recent competition in the "*M.M.*" showed that there are hundreds of talented artists among our readers, and we observe that our enterprising advertisers, Messrs. Lines Bros. Ltd., of London, have been quick to take advantage of this fact. This firm announces a new painting competition with cash prizes amounting to £8/10/-. The competition is quite simple and should appeal to all our readers who are keen on painting and drawing. Full particulars will be found on the inside back cover of this issue.

A New Cannon

An entirely new type of toy cannon, which requires no caps or powder, is being marketed by Messrs. Hanwells Toys (Northampton). This cannon is a solid, well made article and fires a projectile by exploding a match-head in the breech. The noise of the report and the smoke of the discharge are very realistic and the projectile travels a considerable distance. Any amount of fun may be obtained from this ingenious toy, for which we predict a considerable popularity (see page 144).

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Small advertisements are inserted in these columns at 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order.

Obtaining the "*M.M*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The "*M.M.*" is sold Overseas at 2d. per copy, or mailed (post free) direct from Liverpool, 1/6 for six issues, or 3/- for twelve issues.

IMPORTANT.

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA:	Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA:	Messrs. E. G. Page & Co., 379, Kent Street, Sydney.
NEW ZEALAND:	Messrs. Browaing Ifwersen Ltd. P.O. Box 129, Auckland.
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IN one of our previous issues we gave details of how to detect watermarks and also described some common watermarks. This month we are to consider a few more interesting examples of entirely different designs.

The watermark is a sure guide to the date of issue of a stamp. For instance, some stamps are identical in design, colour, paper, and perforation, but may differ in their watermark. The detection of the watermark in such a case enables the stamp at once to be classed in the correct issue, and because of the fact that it may be more scarce in one issue than in another, its value may be considerably increased.

An Interesting Country

Let us take, for example, the early stamps of Queensland. These important stamps have received considerable attention recently from experts, and the full list of the stamps of this interesting country in Gibbons' latest catalogue has been compiled as a result of their studies. Some collectors do not attempt to classify their stamps in so detailed a manner as that set out in Gibbons' catalogue. This may be alright for the beginner, but as soon as stamp collecting is taken up seriously a collector realises that he must discriminate in many cases if his collection is to be a representative one. It is certainly very awe-inspiring to look through the pages of such a catalogue as Messrs. Gibbons'—especially in regard to a thoroughly-studied country such as Queensland—but after all, these long lists of stamps are really quite simple and straightforward. It is only necessary for us to read through them once or twice from beginning to end, and make comparisons with any stamps available, and we lose our sense of awe and come to regard them in their true light.

Queensland Varieties

For example, there are 127 varieties of the first type of Queensland stamps listed by Gibbons, including all the different values from 1d. to £1. Let us see for a moment what causes all these varieties. The first thing we notice is that there are six kinds of watermark. Of these, stamps watermarked with a large star are found either imperforate or perforated. Those with a small star have nine different sizes of perforation, those watermarked "Queensland—Postage Postage–Stamps Stamps" in script throughout the sheet have two; those with a small broad-pointed star have three. The stamps with the fifth type of watermark, a crown over and joined to "Q," have four sizes of perforation; those watermarked Crown over "Q" (Fig. 1) have one size of perforation. There are also two values, 6d. and 1/–, with no watermark.

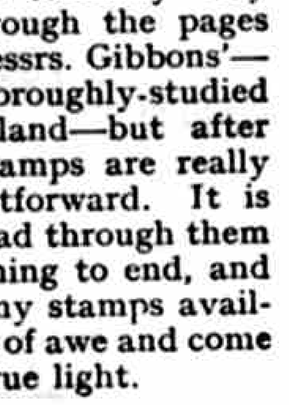


Fig. 1
Queensland

Some of these stamps are worth no more than 2/–, others are priced £120, but there are some so rare as to have no price quotation at all—that is, they are "priceless," or worth what they will fetch.

Identifying Your Stamps

Now, if a collector does not differentiate between different kinds of watermarks, and different sizes of perforation, how is he to know the true value of his stamps? This surely is not a matter for specialists only, but for every one who collects stamps. To know the way about a stamp catalogue is as important to the stamp collector as an accurate knowledge of a time table is to the traveller.

In allocating a stamp of this first type of Queensland to its place in your album, it is best to decide first of all which watermark it possesses; notice its face value, and lastly, if there are shades of this particular stamp, decide to which shade your specimen belongs. If you work in this order with all lengthy lists, the most complicated issues of stamps will soon be easily identified and you will feel like the warriors of old—that you have "conquered" a new country.

Spanish Watermarks

Spain has been rather sparing of watermarks during the seventy-four years of stamp-issuing. The stamps were on plain paper until the issue of April 1855, when a very curious watermark was used. This watermark is best described as a series of "loops" (Fig. 2). In the following January, the same stamps appeared on paper having a watermark of crossed lines, very similar to the present German watermark—which, incidentally, one stamp journal still persists in describing as "chicken-wire!"

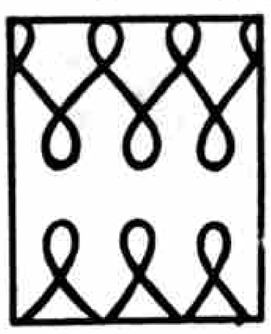


Fig. 2
Spain (1855)

After the withdrawal of this issue, plain paper again was used until 1876, when a watermark of a castle was introduced (Fig. 3). This set is the only one of Spain that has not been printed at the Government Printing Works in Madrid. Apparently the Spanish Government had decided to see what a foreign firm could do in the way of stamp-printing, and Messrs. Bradbury, Wilkinson & Co. Ltd., of London, accordingly engraved and printed this series. The portrait on the stamps is of King Alfonso XII., whom it shows full face. There are two varieties of most values, distinguished by various small differences. The Government resumed printing its own stamps on the issue of the next set, which, as is the case with all that have followed it, had no watermark.

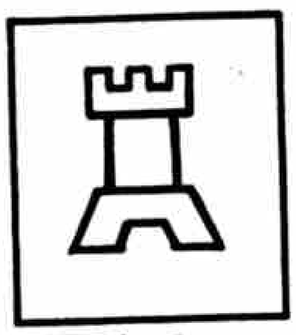


Fig. 3
Spain (1876)

The Argentine Republic

Between the years 1892 and 1895 the Argentine Republic used an unusual watermark. The paper was manufactured locally without a watermark, and afterwards run between rollers which impressed upon the paper a so-called "watermark," showing a sixteen-rayed sun, with eyes, nose, and mouth (Fig. 4). Watermarks of this kind are known as "impressed watermarks," and although they resemble true watermarks very closely, the "watermark" may be seen as a distinct indentation if the face of a stamp is observed from an acute angle.

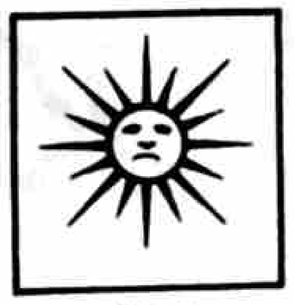


Fig. 4
Argentine

In 1896 the same stamps were printed on paper made in Germany with a real watermark of the same design as before. You will be able to identify either of the two kinds of watermark by measuring the diameter of the sun. In the first, impressed watermark issue, the sun is 4½ millimetres in diameter, whereas in the true watermark issue the diameter is 6 millimetres. Your school geometry ruler is sure to have a millimetre scale on it which you will find very useful in measuring your stamps. Both the above issues of Argentine show portraits of Rivadavia, Belgrano and General San Martin, and were engraved and printed in Buenos Ayres by the South American Bank Note Company. The second set is the rarer, although neither is very high priced.

RECENT ISSUES

SPAIN.

A fourth portrait of King Alfonso now appears on Spanish stamps. The complete set is not yet in circulation, but the values so far issued consist of the 5, 10, 20, 25 and 40c. The normal colour of the 10c. is green, but a few were issued in 1922 in carmine, and this is believed to have been an error. This stamp, owing to the small number of specimens printed is sure to increase in value as the dealers' stocks become exhausted, and at the present price of 7d. is well worth buying.

GERMAN REPUBLIC.

The flood of new issues for the German Republic continues with unchecked speed. There were two picture stamps recently issued, the one illustrated and another value 10,000 marks, showing Cologne Cathedral. That pictured here bears a view of the Wartburg, near Eisenach, one of the most important German mountain castles, specially celebrated through St. Elizabeth of Hungary. Luther lived at this castle for ten months.

NEXT MONTH:—
PERFORATIONS

Competition Corner

SECOND COMPETITION

For Lynx-Eyed Readers

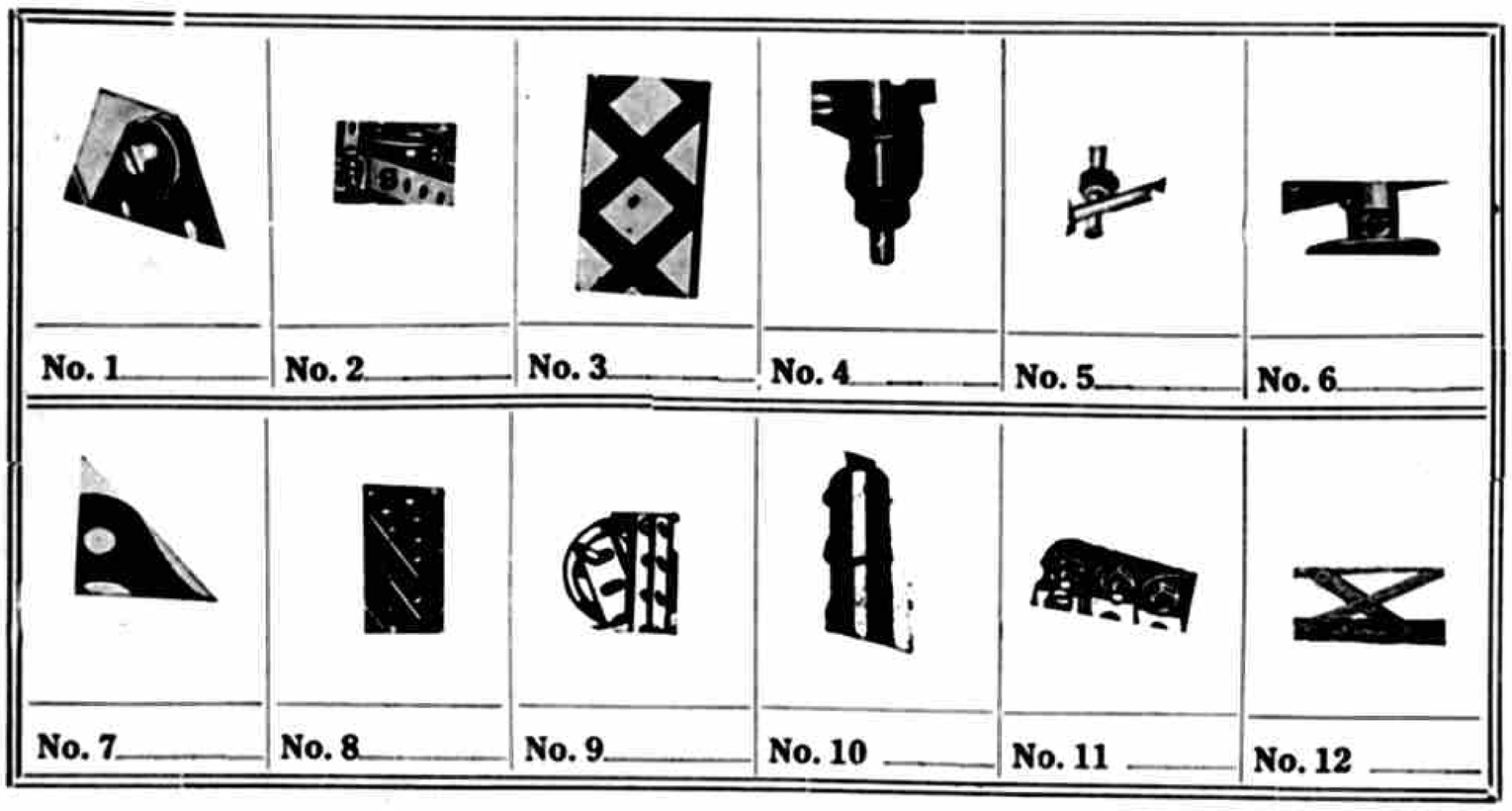
FIRST PRIZE: Hornby No. 2 Tank Loco.

SECOND PRIZE: Meccano No. 1 Radio Receiver.

THIRD PRIZE: Pair Meccano Double Headphones.

CONSOLATION PRIZES: 12 Meccano Writing Pads; 12 Meccano Complete Manuals.

FIRST SET



The great success of our last Puzzle Picture Competition for Lynx-Eyed readers decides us to arrange another of the same kind, but this time the identification of the pictures is going to be made a good deal more difficult! Our readers are far too sharp to be "caught-out" with anything but the most difficult problems, especially where Meccano is concerned, and so we intend to make this second contest a "real teaser!"

There will be three sets of pictures in this new series, and the first set appears above. Two more sets will appear in the next two issues of the "*M.M.*" Each picture is taken from some model in the latest Complete Manual (No. 23). When the picture is identified, the number of the model should be written in the space beneath. Readers possessing an 0-3 Manual only, should obtain a copy of the Complete Manual if they wish to compete, as many of the models are not featured in the smaller Manual. Competitors are required to solve all three sets to qualify for a prize, but *no entries are to be sent in until the last set has appeared.*

If you are an enthusiastic model builder, you will have little difficulty in identifying these pictures. If no competitor succeeds in numbering all the models correctly, the First Prize will be given to the reader whose results are nearest correct. The other prizes will then be awarded in order of merit. If more than one competitor ties for any prize, the prize will be awarded to the neatest entry.

As we know that most of our readers wish to keep their copies of the "*M.M.*" intact, it should be clearly understood that competitors are not required to tear out the pages containing the Puzzle Pictures. Solutions will be written on a postcard as in the last contest; the space and number beneath each picture is provided for the convenience of competitors only.

Essay Competition

As announced in our last issue the subject of this competition is:—"MY FAVOURITE MODEL AND WHY I LIKE IT." Essays should not exceed 500 words and should be written on one side of the paper only. The competitor's name and age should appear on the back of each sheet, as it is possible that odd sheets may get astray if they do not bear the author's name.

The competition will be divided into two sections:—

(A) Under 12 years of age.

(B) 12 years of age and over.

A prize of a film-pack camera (taking pictures $3\frac{1}{4}" \times 2\frac{1}{4}"$) will be awarded in each section. The closing date is May 30 in the United Kingdom (Overseas: August 30.)

Competitors will please remember that the task of judging the entries is rendered easier if the essays are neatly and clearly written.

Essay Competition for Cyclists

Last month we announced an Essay Competition for Cyclists, the subject being "The Ideal Bicycle." Competitors should describe the kind of bicycle they would best like to own; whether three speed, two speed or single speed; dropped handle bars; with or without chain case, etc. Essays should not exceed 500 words and should be posted before May 30, addressed "Cycling," *c/o Meccano Magazine*, Binns Road, Liverpool. The prize will be a Veeder "Regular" Cyclometer.

Result of Stamp Essay Contest

When a boy is invited to write about his hobbies his only difficulty, apparently, is to confine himself to 500 words! Every entry in our second Contest for Stamp Collectors was so interesting that had not the judges themselves been keen philatelists before this competition, the glowing essays would certainly have tempted them to take up the hobby!

The subject of this Essay was "MY FAVOURITE STAMPS AND WHY I LIKE THEM" and the competitors' selections were very wide and varied. A few years ago the wonderful picture stamps of Labuan and Borneo were the most popular with young collectors, but now-a-days it would seem that these old favourites must give place to the scenic views of Jamaica and the larger stamps of the U.S.A.

The best essay received was one on the stamps of the French Colonies, i.e., Gaboon, Côte d'Ivoire, Mauritania, French Sudan and Somalis. This was written by MASTER D. F. HASLEWOOD, of Acomb, York, who has chosen 10/6 worth of stamps from our advertisers, Messrs. Norris & Co., as his prize. Special mention must be made of the following: MASTERS D. J. HOPKIN, of Bristol, W. G. DOWNEY, of Southend-on-Sea, and G. WHEELAN, of Glasgow, who sent in very good essays indeed.

Result of Lynx-Eyed Competition

About a year ago we published a competition in which readers were required to classify the errors in a sketch of a loco. This Competition proved how very sharp and enthusiastic Meccano boys really are, but we scarcely expected such a huge number of entries as we have received for our recent Puzzle Picture Contest. "Sharp-Eyed" competitors have apparently told all their "Lynx-Eyed" friends about the former contest, with the result that from the day the last set was published, we have been deluged with entries at the rate of hundreds per day. Every entry has been carefully checked and we are now able to publish the names of the winners:—

FIRST PRIZE (Hornby No. 2 Passenger Set)
MASTER BERNARD J. J. BANNER, of Forest Town, Mansfield, Notts.

SECOND PRIZE (Zulu Goods Set)
MASTER N. F. BECKETT, of Bromley, Kent.

THIRD PRIZE (Meccano Electric Motor)
MASTER DOUGLAS SMITH, of Wellington, Salop.

12 CONSOLATION PRIZES of Meccano Writing Pads, to the following competitors:—Masters T. A. H. Adkins (Elland), Denis Bates (Liverpool), Vernon Coslett (Cirencester), Verna Davey (Otley), Norman Douglas (Inverness), Teddy Hunt (Hull), W. J. Kiddis (Morley), Edgar Norris (Bolton), Donald Reid (Southport), Ronald Rhymes (South Devon), James Sharp (Birmingham), George Shalley (Birmingham).

12 CONSOLATION PRIZES of Complete Manuals of Instruction:—Masters Philip Bourne (Birmingham), S. H. Judson (London, N.W.5), J. H. Kettle (Loughborough), Stanley Perks (Birmingham), V. F. Ross (Dundee), D. B. Rubie (Lemsfield), H. D. L. Simpson (Sedbergh), Raymond Tree (Plymouth), Eric Watson (Blackburn), Leslie Welland (Thames Ditton), George Williams (London, S.W.15), G. I. Woolsey (Scarborough).

Those readers who were unsuccessful in this Competition will be interested to see that we are publishing a further series of Puzzle Pictures in which more splendid prizes will be awarded.

FOR
OVERSEAS READERS

Essay Competition for Stamp Collectors

Our last essay contest (the result of which is announced elsewhere on this page) clearly showed that there are many thousands of keen stamp collectors among our readers, and as announced last month, we have decided to hold an essay competition for Overseas readers on the same subject—"*My Favourite Stamps and Why I Like Them.*" Some special set, or stamps of a certain colony or even stamps of a country should be chosen and described, and the reasons for your choice given. The essay must not exceed 500 words and is to be written neatly on one side of the paper only. Envelopes containing the entries should be marked "Stamp Contest" in the top left hand corner and sent to the Editor of the "*M.M.*," Binns Road, Liverpool.

The first prize will be stamps to the value of 10/6, to be chosen by the winner himself from any firm advertising in the pages of the "*M.M.*" Make your choice when you send in your essay, and give full particulars of the stamps required, so that the prize may be sent direct to you in the event of your success. Closing date for Overseas Readers: June 30, 1924.

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FROM 77/6

Mending a Puncture

by "ROVER"

OF the many things that annoy the cyclist—such as bad roads, squeaky saddles, skidding, and lamps that won't light—pride of place must certainly be given to the ever-dreaded puncture. A puncture is exasperating when it occurs while we are riding along a charming country road on a fine summer day, but it is a really maddening experience on a cold dark night, when we are miles from anywhere and the rain is coming down in torrents.

"Be Prepared!"

When a puncture occurs it seems to be quite the general thing for the cyclist to first express his frank opinion of tyres in general and of his punctured tyre in particular, and then to commence to repair the damage—that is, provided he has not forgotten his repair outfit! If he has forgotten it, then he will have to "foot it" to the nearest bicycle shop. During the walk he will find plenty of time to meditate on the famous motto of the Boy Scouts!

The experienced cyclist never starts out on a long run without a complete tool kit, which always should include a puncture repair outfit. The contents of all repair outfits are usually very similar, and consist essentially of a tube of rubber solution, an assortment of rubber patches for inner and outer tubes, sand-paper, and some French chalk.

Finding the Puncture

The first step in repairing a puncture is to take off the lamp and then turn the machine upside-down. If you forget to remove the lamp you will find, when you want to light it, that all the oil has run out, and you may easily be stranded in this way. When the machine has been turned upside-down, the next step is to release one side of the outer cover so as to get at the punctured inner tube. First slack-off the holding-down nut of the valve—that is, the nut that bears on the rim—and then free one side of the outer cover with tyre-levers, which should be in the tool kit. By careful manipulation of the loosened outer cover the whole of the inner tube may be gradually slipped out, with the exception of the valve portion, which remains owing to the valve being still in the rim.

The next thing is to ascertain the position of the puncture. If a bucket of water is obtainable, pump up the inner tube and insert it in the water, section by section, until rising air bubbles denote the location of the puncture. If there is no water at hand, the tube should be pumped up and carefully examined, as it is sometimes possible to find the puncture by the sound of the escaping air alone. When the puncture is finally located, examine the cover to see if the nail or thorn that caused the damage is still in the cover. If so, extract it, or it will cause another puncture as soon as you return the tube into position.

Repairing Operations

Then dry the tube, clean up the portion round the puncture with the sand-paper, and smear a little of the solution around the puncture. Choose a repair patch of suitable size, moisten it with the solution, and expose it to the air for a few moments until it becomes quite sticky. It is important to use the smallest possible quantity of solution, working it in with the finger into both the inner tube and the repair patch. When the solution has become "tacky," as it is called, place the patch over the puncture, and it should at once adhere to the tube. Press down all round the edges, and after dusting over with French chalk to cover any surplus rubber solution, leave the patch to dry, allowing about five minutes before gently pumping up the tube and testing.

If no leak is detected, the inner tube may be deflated and placed in position, and the outer cover replaced by means of the tyre levers. Make sure that the valve is in place and secure before finally pumping up the tyre preparatory to remounting.

Self-Sealing Solutions

It is an old saying that "prevention is better than cure," and many cyclists prefer to prevent punctures rather than mend them. This may be done very effectively by using one of the "self-sealing" solutions now on the market. These solutions are poured into the inner tube, where they remain as long as the tube lasts. They automatically seal up all punctures so quickly that the tyre never deflates, and the cyclist does not know that he has had a puncture. The Editor of the "*M.M.*" will be pleased to send particulars of these solutions, names of makers of reliable puncture repair outfits, and advice on cycling matters generally to readers. Envelopes should be marked "Rover," and the questions clearly and briefly stated. Matters of general interest will be replied to on this page from time to time.

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NEXT MONTH:

TOOL KITS:

What they should Contain

The Secretary's Notes

With the advent of cricket and tennis this month, many clubs will commence their Summer Session. Judging from the programmes and reports I have received from Club Leaders and Secretaries, this outdoor Session will prove every bit as enjoyable as the Sessions spent in the club-room. Scouts, Naturalists, Photographers, Cyclists, Cricketers and Swimmers are busy preparing for their own particular hobby, and in the larger clubs special sections are being formed for these outdoor activities. For "lone members" of the Guild, the summer months offer great opportunities for spreading the Guild movement among other boys. By wearing their badges every day and taking care to have a supply of application forms ready, new recruits may be enrolled and a Recruiting Medallion won. By getting their friends together and organising Cricket or Rambling Clubs, all will become better acquainted, and when the winter months come "lone members" will be able to consider with their new friends the question of starting a club and initiating themselves into the joys of club night.

Outdoor Sessions

For members who have not yet won a recruiting medal, or for those who wish to have their names engraved on the one already in their possession, the summer months offer a golden opportunity. New friends are made on the cricket fields, and during the holidays. Once these boys hear of the fine times enjoyed by Club members, they will be anxious to join the Guild. The next few months will give members ample time and opportunity to "rope-in" that one recruit that I have asked them to secure. Many boys have already sent in the name of their new member, and to each of these I have written personally. I wish to take this opportunity, however, of again thanking these members for their prompt response to my suggestion, as mentioned in these Notes last month. I am ready to send Application Forms and Leaflets describing the Guild and its activities, post free on application.

Recruiting Award

Secretaries of unaffiliated clubs should also make a new endeavour to find Leaders and club rooms during the next few months. By vigorously making enquiries among their friends, they may hear of someone who will be willing to undertake the responsible duties of Leadership. An interview is by far the most satisfactory arrangement, though when this cannot be arranged, I am always very glad to write and explain matters, if given the name and address of the proposed Leader. Sometimes the local Scoutmaster will be able to help, for some of the largest and most enthusiastic Meccano Clubs in this country are run in conjunction with Scout troops.

Opportunities for Clubs

The summer months are ideal for fostering the Guild spirit, for above all, the Meccano boy is a sportsman, and he proves it to others by his actions and behaviour both at work and at play. A few years ago a big Meccano club organised its first cricket team and all the members were very keen cricketers. Skippered by the Club Leader, they had a very busy and enjoyable session playing other local teams. Towards the end of the season the Club Leader received a note from the Headmaster of a large school, inviting the club team to come over and play his school. The reason he gave for the invitation was that he had heard from the masters and cricket-captains of several other schools "*that the Meccano boys were all thorough sportsmen.*" This, of course, was a very great compliment to the club, and it showed that the team were all true Meccano boys and worthy members of the Guild. Every Meccano Club will not receive compliments like this during the coming session, but they can all deserve them—which, after all, is what really matters!

Guild Spirit

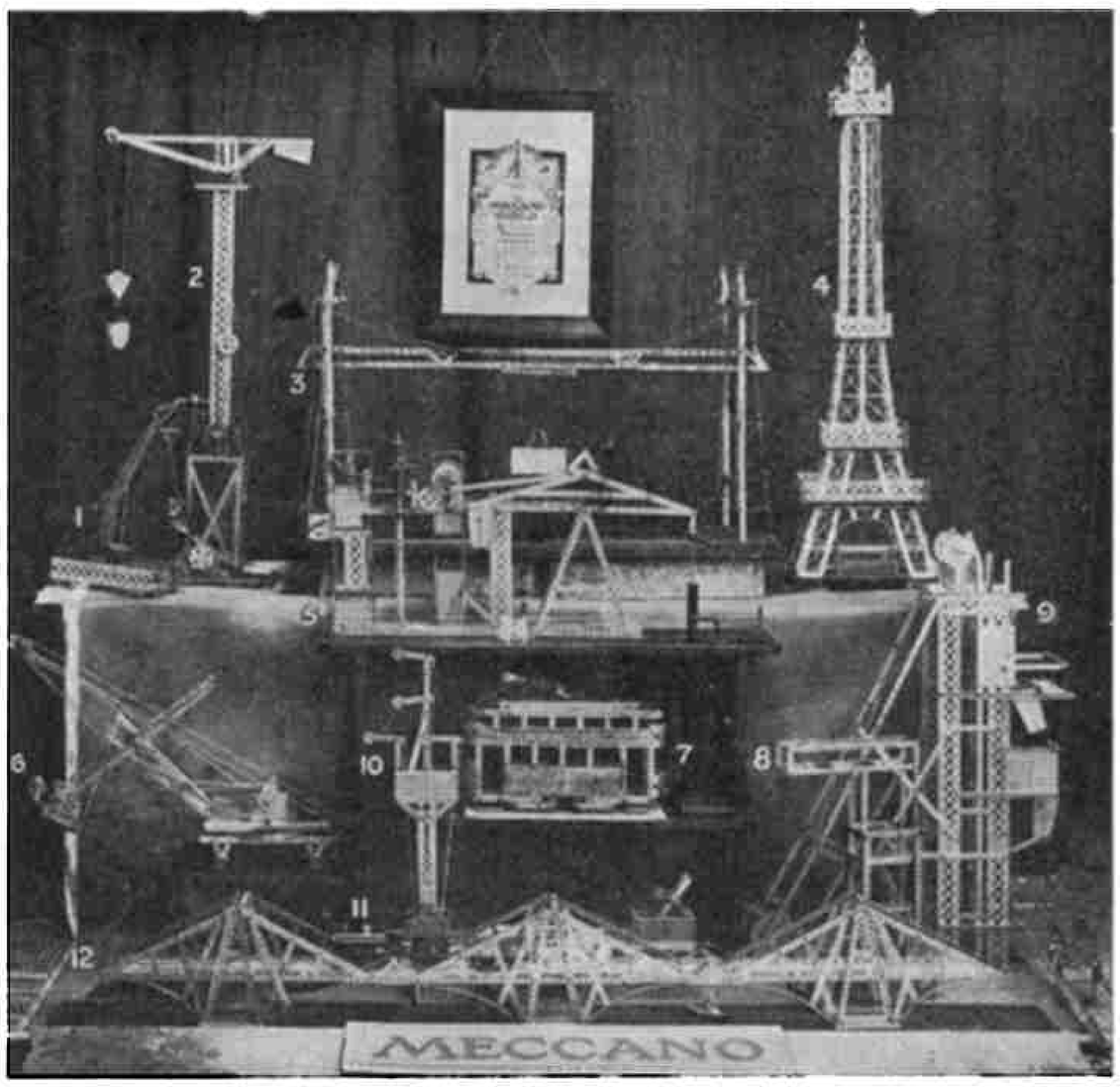
It should be the aim of every Club to become widely known in its particular locality and thus gain more local support. It is not a bad idea to appoint one of the members Press or Publicity Secretary. His duty will be to send short reports of the Club's activities and notices of meetings to the local newspapers and to do everything possible to advertise the existence of his Club. The Parish Magazine, too, is an ideal medium for Club notices, which should include the name and address of either the Club Leader or Secretary, for the benefit of intending members. If no Press Secretary is appointed, the Club Secretary should himself make a point of sending in his report to the newspapers regularly each week and in good time for publication. Promptness and accuracy are necessary when dealing with newspapers, and if care is not exercised in these matters the Editor may quite naturally think the Club is not enthusiastic and may consequently decide not to insert further announcements.

Clubs and Publicity

Exhibition of Models

BY A SOUTH AFRICAN MECCANO CLUB

It is pleasing to learn that on the occasion of a recent War Memorial Exhibition held at Observatory (a suburb of Capetown) the assistance of two of our South Africa Meccano Clubs was invited. These were the Observatory and the Simon's Town Clubs. The former club has the distinction of being the largest Meccano Club in the world, and the latter club, though only recently affiliated, has already made splendid progress.



Our illustration shows the models built by the club members displayed at the Exhibition, (1 and 2) Different types of cranes. (3) Transporter Bridge. (4) Eiffel Tower. (5) Cornish Pump. (6) Steam Shovel. (7) Tram Car. (8) Tower Wagon. (9) Mine-Head Gear. (10) Signal Gantry. (11) Hornby Train and (12) Forth Bridge. It is interesting to note that No. 5, the Cornish Pump, was a prize-winning model in the £250 Prize Competition held last year, while No. 6, the Steam Shovel, was also awarded a Certificate of Merit in the same contest.

The excellent taste shown both in the grouping of the Models and the position of the framed Club Certificate makes this exhibit one of the best we have seen for some time.

We are pleased to take this opportunity, on behalf of all Guild members, of congratulating our two enthusiastic Overseas Clubs on their display and on the interest it aroused.

CLUB NOTES

Luton M.C.—Several members are interested in Wireless and have been busily engaged in making Crystal Receivers. An interesting wireless evening was held some time ago. The Session closed on the 26th of last month with a social evening, which everyone present thoroughly enjoyed. *Secretary:* Master W. Humby, 11, Napier Road, Luton, Beds.

Liscard High School M.C.—Recently celebrated the fifth year of its existence, when thirty new members were enrolled. The club is divided into three sections, namely Engineering, Scientific and Miscellaneous. Outings, including visits to the Bidston Observatory and two football matches, have been greatly enjoyed by all sections. *Secretary:* Master B. Warburton, 11, Brisbane Avenue, New Brighton.

Parkstone Congregational M.C.—Chiefly owing to the increase in membership, it was recently decided to divide this club into two sections, Junior and Senior. An Assistant Secretary has therefore been appointed to the Junior Section. The new arrangement will no doubt be found a great improvement. *Secretary:* Master Stuart Bridle, "Newton Glen," Sandbanks Road, Parkstone Road, Dorset.

Ethersall M.C.—Master H. Dewhurst, who, in his capacity as Secretary has done a great deal of valuable work for this club, has, unfortunately, been compelled to resign on account of his health. Master L. Hansfield has now taken over the duties and reports that new members continue to join at every meeting. A recent lecture on "Mechanical Principles" was followed by a debate. *Secretary:* Master L. Hansfield, 7, Spring Street, Nelson, Lancs.

Leckhampton M.C.—Continues to make steady progress and reports a slight increase in membership. A football team was recently formed, and it is also hoped to secure the use of a cricket ground for the summer months. A model-building contest is held every month, while other evenings are devoted to indoor sports and games. *Secretary:* Master B. Rhodes, Cotswold View, Charlton Lane, Leckhampton, Cheltenham.

House (Guernsey) M.C.—At a recent meeting it was decided to issue a Club Magazine to be known as "Meccanotes." A model-building competition was held during the past session and several very ingenious models were exhibited. *Secretary:* Master H. Griffiths, Elizabeth College, Guernsey, Channel Islands.

Bromley C.C. M.C.—Has passed an enjoyable and successful session, and reports a slight increase in membership. In recent model-building contests it was found that the most popular models with members were 'buses and lorries with special springing and steering. A combined delivery-shute and pit-head gear worked by weights only, was exhibited at a club evening and earned considerable praise for its young constructor. *Secretary:* Master C. G. Swan, Bromley County Council School for Boys, Hayes Lane, Bromley, Kent.

Footscray M.C.—Has recently joined forces with the local Scout Troop and is sharing the new Hall with them. This makes an increase in membership possible, and twenty new recruits have been enrolled. Ammunition, rope, woollen and glass works have been visited at various times. Enthusiasm is a marked feature of this progressive Colonial club. *Secretary:* Mr. H. L. Roach, 48, Sterling Street, Footscray, Victoria, Australia.

Leamington M.C.—The programme for the past session included several interesting lectures and papers, including "How to Re-enamel a Bicycle," "Model Railways," "Ins and Outs of Wireless," and a lantern lecture entitled "The Romance of the *Daily Mail*." A speed and accuracy contest was also held, while considerable amusement was caused one evening by every boy being called on to either deliver a lecture or make an impromptu speech. *Secretary:* Master A. R. Mannall, 12, Lansdowne Circus, Leamington Spa.

Garstang and District M.C.—This club has been passing through a somewhat critical period lately, but fortunately, owing to the exertions of the Secretary and some of the more enthusiastic members, the future now looks more promising. New members are cordially invited to write for full particulars, as it is desired to increase the club membership. *Secretary:* Master Lionel A. Nutley, Church Street, Garstang.

Club Recently Affiliated

St. Mark's M.C.—A new and larger club room was secured some time ago, in which the first event held was a Motor Derby. Other activities made possible by the increased space include, Boxing, Tennis, Foils and Ping-Pong. The members will carry-on during the summer months as the Albion Rambling Club. *Secretary:* Master L. Jones, 39, Wellmeadow Road, Hither Green, Lewisham.

How to Run a Meccano Club

by the Guild Secretary

Affiliation with the Guild

When your Meccano Club is thoroughly established and has an adult Leader and a Club-room, and when meetings are being held regularly, application may be made for affiliation with the Guild. An affiliated Club is able to avail itself of certain privileges, such as the loan of Meccano lectures, short stories, and suitable plays for Club nights; the loan of working Meccano models for instruction, lantern slides (when available), and Meccano posters and printed matter for exhibitions. Individual members of an affiliated Club are elegible for the Special Merit Medallions awarded for service to the Guild.

Applications for affiliation to the Guild should in every case be made by the Club Leader, who should give the following particulars if there has been no previous correspondence to enable them to be extracted:—Name and address of Club and Leader; number of members on the roll; short report and balance sheet.

These particulars are placed before the President of the Guild and, subject to his approval, affiliation is granted. A certificate, beautifully printed in colours and measuring 23" × 18", is then despatched to the Club. This certificate is signed by the President, and is very suitable for framing and hanging in the Club-room.

The Four Sessions

The year is divided into four sessions. The winter session dates from October 2, the second winter session January 1, the spring session April 1, and the summer session July 1. Formerly, the Guild recognised only the two winter sessions, but lately there has been an increasing demand that a summer session should be arranged, so that the members may keep together and enjoy each other's company during the fine days of summer.

Wise Leaders always endeavour to arrange rambles, cycle-runs and cricket-matches during the summer months. Our President, Mr. Hornby, is particularly keen on outdoor sports, and desires to encourage all Meccano boys in this direction as much as possible. It seems only reasonable, therefore, that the Guild should have summer sessions, and that these should be as important and as enjoyable as those of winter.

The Club Programme

It is well to arrange a programme at the beginning of each session, and this programme should be adhered to as closely as possible. The programme may be arranged by the Leader and Secretary, or better still, at a general meeting held at the commencement of the session. It is difficult to please everyone, and the subjects should be those desired by the majority of members. The summer sessions are not difficult to arrange, but the winter sessions provide a little more difficulty. There are so many subjects and there is so much to do on Club nights that sometimes the programme may be satisfactorily arranged only by taking a vote.

Considerable care should be taken in drawing up the programme, because upon it may depend the success of the Club. The work of the session should be made as attractive and as interesting as possible, so that members will really want to come on Club nights, attracted by the interesting subjects. Next month I hope to give a suggested syllabus which may serve as a guide for new clubs.

Meccano Club Leaders

No. 13. Mr. RUDOLPH SAMUEL

The Liscard High School Meccano Club is fortunate in having Mr. Rudolph Samuel as Leader, for he has long been interested in boys and their hobbies. Before taking over the Leadership, Mr. Samuel was for some years Scoutmaster of a local troop, and was therefore well-equipped with the experience thus gained. Membership of the Club is limited to pupils of the Liscard High School, but under Mr. Samuel's able Leadership, the club has grown from a few boys interested in the Meccano hobby, to its present membership of nearly 40. It is now in its fifth year of existence, and the present Leader has been in office since 1922.

The Club's activities are continued during the summer months, when cycling tours are regularly arranged by the Leader. Several interesting visits have been paid to local factories, including the Meccano works. In the winter, knotting, splicing, first aid, and football are popular, in addition to model building evenings and lectures, on which the members are very keen.

Clubs not yet Affiliated

Bombay M.C.—Is endeavouring to persuade a local gentleman to take over the position of Club Leader, when affiliation with the Guild will be granted. Members are all enthusiastic and several very enjoyable meetings have recently been held. *Secretary:* Master P. Daver, Bhiwandi House, Gwalia Tank Road, Bombay.

Ilfracombe M.C.—Has recently come under the guidance of a Club Leader, and will shortly be affiliated. A successful social was held some time ago, when each member brought a friend. Some original models were exhibited. New members are heartily welcomed and full particulars may be obtained from the *Secretary:* Master W. Webber, 14, Springfield Road, Ilfracombe.

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WOMEN

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Fireside Fun

DURING the past few weeks the Editor's tongue has been kept busy endeavouring to avoid the pitfalls prepared for it by ingenious compilers of tongue-twisters! Since the last tongue-twisters were published on this page we have received hundreds of letters from readers who evidently take a keen delight in evolving tongue-twisters, which they hope will tie any tongue into a hopeless knot! Many of these tongue-twisters are original, but others are of quite a respectable age. There are, for instance, dozens of sentences regarding a certain ancient person named "Peter Piper," but even his popularity has been exceeded by a young lady named Betty, whose life's aim seems to have been to buy some bitter butter! Then Sister Susie, who was very popular a few years ago, appears to have commenced sewing shirts for soldiers again, and many other well-known twisters have been resurrected in the hope that they would confuse the Editorial tongue—but so far they have not succeeded!

* * * *

There is no doubt that tongue-twisters are very popular with our readers, and we are printing some more this month, and shall follow them with further selections in our future issues. In the meantime, if any reader is able to quickly say the following twisters a dozen times without taking more than one deep breath, his best plan will be to endeavour to get father, or some friend, to try his luck!

* * * *

She stood on the step welcoming him in.

* * * *

A saucer full of Worcestershire Sauce, sir.

(These two tongue-twisters are contributed by Master D. R. Brown, Sidcup, Kent).

* * * *

There was an old woman who was a thistle sifter. She had a sieve of sifted thistles, a sieve of unsifted thistles and a sieve of thistles to sift and so she certainly was a thistle sifter.

(Contributed by Master A. L. Cruickshank, Aberdeen).

* * * *

A pretty crop of poppies in a copper coffee pot.

(Contributed by Master R. Bigg, Salisbury).

* * * *

Lady (watching workman): "Are you copper-bottoming 'em, my man?"

Workman: "No, mum, I'm aluminiuming 'em, mum!"

(Contributed by Master R. Lant, Burnley).

Dick: "I see they are able to make engine-wheels out of paper now."

Jim: "Is that so? I suppose they use them for stationery engines!"

"Why do I live?" was the title of a poem recently submitted to an Editor (not the Editor of the "*M.M.*" though!).

The editor's reply was: "Because you sent it by post instead of coming round with it?"

* * * *

Dobson: "The finest thing you can eat—an apple. 'An apple a day keeps the doctor away.'"

Hobson: "That's right, old chap, and an onion a week keeps everybody away!"

* * * *

Puzzle No. 19.

There are sixty-four squares on a draught board. On the first square you place one farthing, on the second two, third four, fourth eight, and so on. Keep doubling the last amount with each successive square. How much would it come to?

(Answer Next Month.)

We offer a prize of 5/- for the best puzzle submitted each month, and prizes of 2/6 each for any other puzzles printed.

Puzzles should be expressed as clearly as possible and the answers should be given in each case. Diagrams should be clearly drawn and letters should be addressed "Puzzles," Meccano Magazine, Binns Road, Liverpool.

This Month's Short Story.

Man. Bus.
Run. Fuss.
Wrong bus.
Man cuss.

* * * *

"Father," said Dick, "you know that field, where the wild beast show is being held? Well, I saw a lion and a lamb lying side by side in the open field this morning."

"Nonsense, Dick!"

"I tell you I did," persisted Dick, edging away, "but it was a dandelion!"

* * * *

An Irishman was handling dynamite in a quarry. He let a stick drop, and the whole box went up, taking him with it. The quarry boss came around later and said to another Irishman:

"Where is Mike?"

"He's gone," replied Pat.

"When will he be back?" asked the boss.

"Well," replied Pat, "if he comes back as fast as he went, he'll be back yesterday."

Answers to Last Month's Puzzles

No. 17.

Brown bought 25 geese at 5/- and meant to ask 6/3.

No. 18.

A *Sutler* sat in his *ulster* grey,
Watching the moonbeams' *lustre* play
On a keg that in the bushes lay,
And the leaves with their *rustle* took up the song:—
"Thou *lurest* the brave; Thou *rulest* the strong,
To thee doth *result* of great battles belong,
John Barleycorn, my king."

* * * *

The puzzle competition that we recently organised has brought a large number of entries, and it will take some time to classify them. We hope, however, to announce the result in our next issue.

* * * *

An excellent form of puzzle has been submitted by Master Sheddon, of Cathcart, Glasgow. The puzzle is to fill in the blanks with names of well-known newspapers, magazines or periodicals. Our monthly award of 5/- has been paid to the sender of this puzzle, and 5/- will be paid for the first correct solution received by the Editor of the "*M.M.*" Solutions should be written on post cards and competitors are only required to give a list of the missing names. If you cannot guess all the names, send in your solution with as many answers as possible.

Puzzle No. 20.

The —— were hard; the feet of the —— man sounded on the frozen roadway, and the —— rose-trees in the garden were leafless. The —— fires formed a perch for half-starved birds, and the —— showed like a —— of fire in the sky. To the —— it seemed a hard, cold ——, and, to tell the ——, it was so. A train went by at —— speed, bearing the —— of letters from the country together with the —— from a great town. A —— description of the scene was written in —— for those who live a —— and do not hear the ——.

(Answer Next Month).

* * * *

Another good form of puzzle is that of hidden names, and the following four examples have been submitted by Master R. F. Lawson, Welling, Kent. The names of four animals are hidden in these four examples, the letters running one after the other in their correct order.

Puzzle No. 21.

(a) Poor wretch! A moisture filled his eye.
(b) Do not rebuff a lonely boy.
(c) Said he "If ere I sink and die."
(d) Your smile, O pardre, will be joy.

(Answers Next Month).

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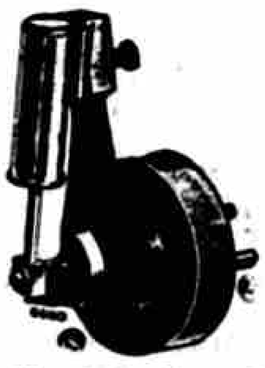

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Entries must reach us not later than June 10th.

The decision of Lines Bros. will be final.

Names and addresses of the winners will be published in the July issue of the *Meccano Magazine*.

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May, 1924

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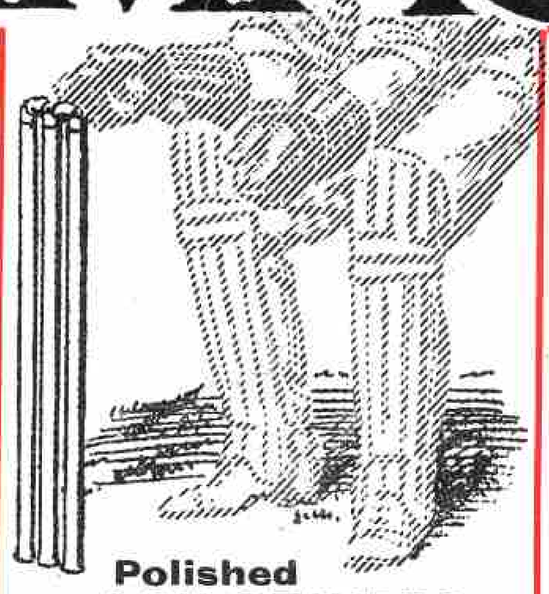

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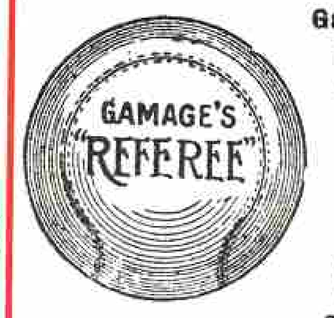

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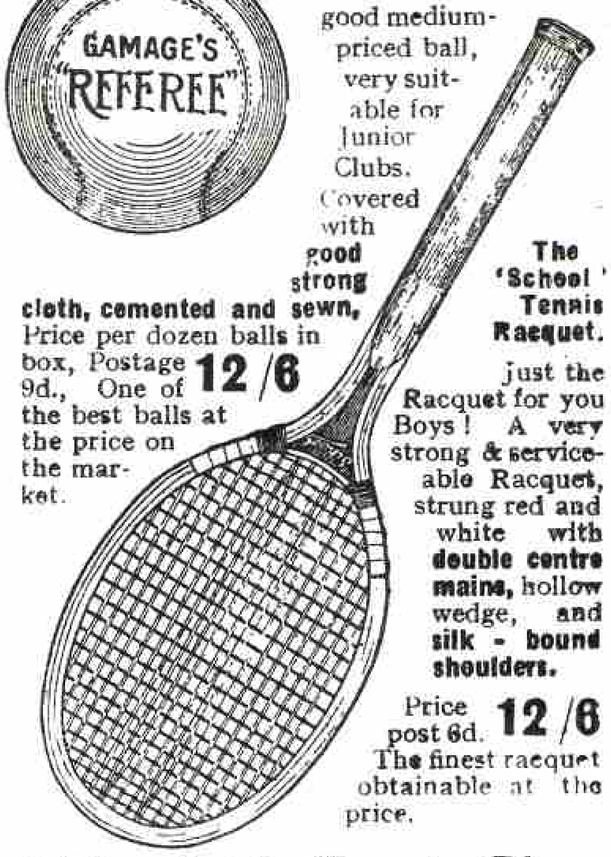

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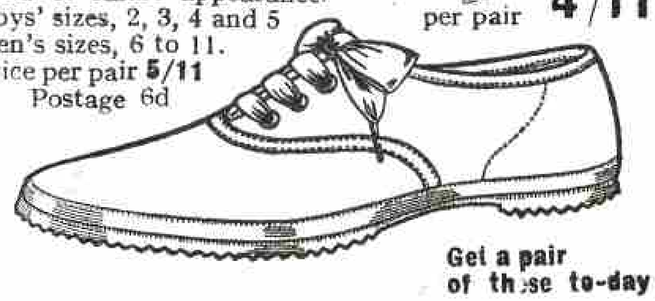

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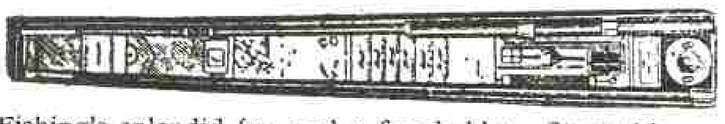

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